

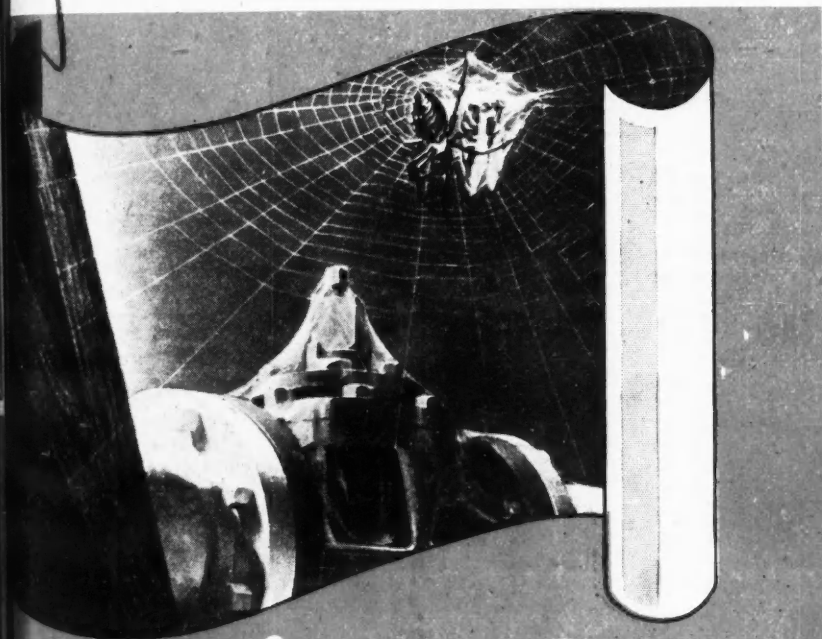
The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

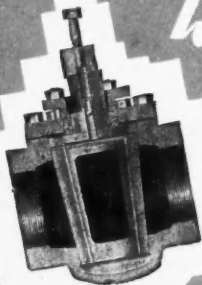
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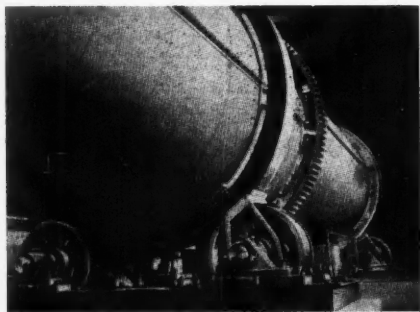
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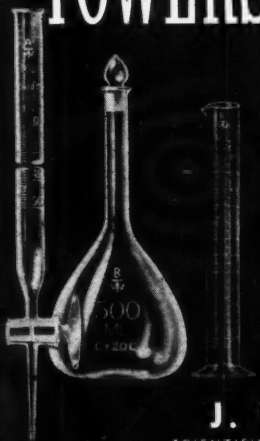
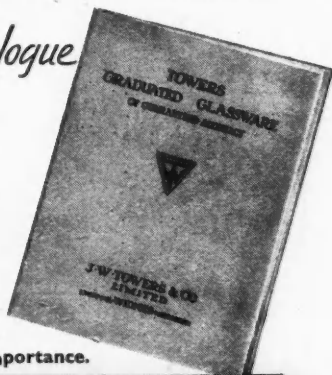
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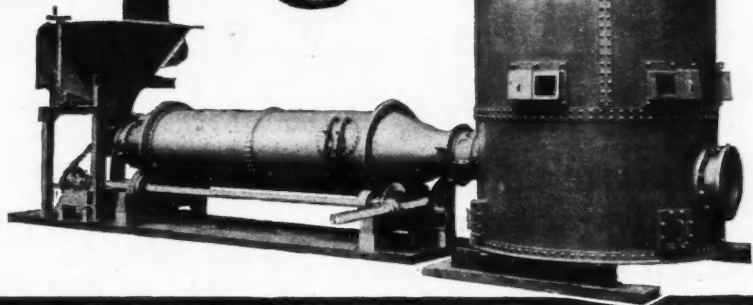
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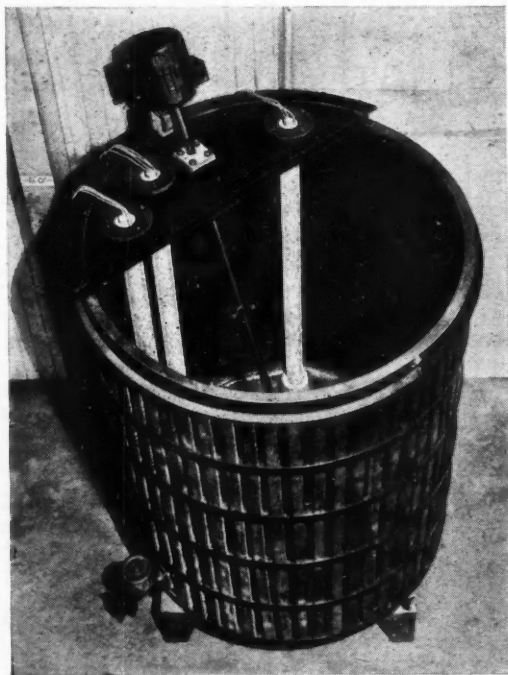
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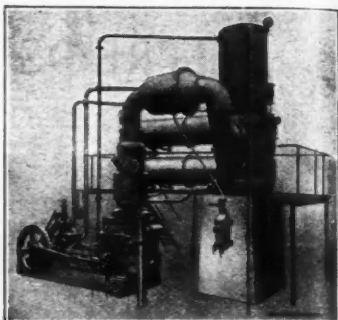
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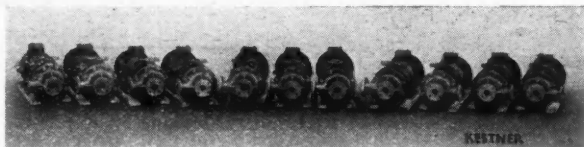
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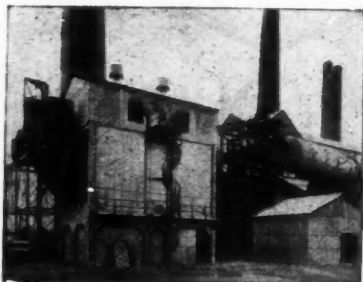
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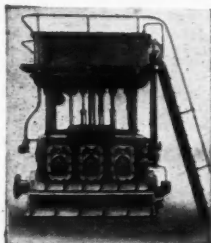
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VOL. XLIX
No. 1257

July 31, 1943

Annual Subscription 21s.
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Organic Chemical Industry

THE condition of British organic chemical manufacture is causing uneasiness. Other nations are preparing for post-war trading developments, while we in this country seem contented to believe that the methods and products that have served us in the past will continue to do so. On May 22 last we commented in these columns on the need for a new policy in regard to petroleum refining, so that there would be available adequate supplies of raw materials for a British organic chemical industry parallel with that now springing up in America. Dr. F. Kind of the Manchester Oil Refinery, Ltd., who has long been known for his advocacy of home refining of petroleum, discussed this subject in our correspondence columns at some length on June 12. He pointed out that the development of a chemical industry from the lower oilfields dates back only some 8 or 10 years; it is perhaps inevitable that there should have been no developments in this country during that time, since British industrialists have never been very "quick on the draw" in starting new manufactures. The idea that if someone else does the development work, we can come in on an upper floor without expense, dies hard—but it is dying at last.

The immense potential demand for raw material for the chemical and allied industries, coupled with the obvious disinclination of the petroleum industry to provide what is needed, has made us look to coal as our primary raw material. Here the position has changed beyond recognition during the past decade. A short time ago we could hardly discern the possibility of using coal for this purpose, and there was no obvious means of discovering methods or of developing processes. Within the last few years, and to some extent since the war, all that has changed. The chemical industry of this country prefers to carry out research individually rather than collectively. We do not criticise it on that account. The diversity of products and of problems makes an attack by a research association a matter of some difficulty. But the fact that there is no research association for the chemical manufacturing industry means that only a firm of immense capital resources—large enough to finance a research association by itself—can engage in the sort of work that is necessary to develop major new branches of activity. That is a weakness of the British chemical industry, and it is only partly remedied by

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the existence of one such firm in Imperial Chemical Industries. There have been set up, however, two research associations able to do much of the spade work, and to show how to produce at least the intermediate products required for the newer forms of synthetic organic chemistry. These are the British Coal Utilisation Research Association and the Gas Research Board.

Two objectives of the B.C.U.R.A. are all embodied in the general statement that it exists to promote the better utilisation of coal. Much of its work, such as research into the design of coal-burning appliances to avoid smoke, and to use coal with better efficiency, and the development of the traction gas producer, are of little direct interest to the chemical industry, but many in the coal industry look forward to the inception by the B.C.U.R.A. of work on the utilisation of coal as a raw material for other industries.

It is, however, of the Gas Research Board that we would here speak. It might be supposed that the gas industry was concerned with the chemical industry only in so far as it provided tar, ammonia, sulphur, cyanides, and similar products which could be used for the production of chemical materials. That was true a few years ago, but it is not true to-day. Dr. J. G. King, the new Director of Research of the Board, has lately addressed the gas industry and has given them his appreciation of the potentialities of research. An important section of those potentialities concerns the production of possible chemical raw materials by processing coal in new ways. We are already familiar with the hydrogenation of coal and with the general outlines of the Fischer-Tropsch process. These as ordinarily operated lead to the production of oils; the Fischer-Tropsch process can be modified to produce gases. In addition there is the Lurgi process of hydrogenation under pressure in the water-gas generator. This process operates at some 300 lb./sq. in., using a blast consisting of oxygen and steam; it is considered that oxygen of the required degree of purity (the standard is not over-high) could be produced at 6d. per 1000 cu. feet. Both the reactions: $C + 2H_2 = CH_4$ and $2CO = C + CO_2$, are displaced to the right by increase of pressure. This process is being combined with

a second stage which manufactures gas by the hydrogenation of coal at 750 lb./sq. in. Thus a two-stage process is being developed which will first hydrogenate the coal while in the process of carbonisation and then produce water gas and methane from the coke. Obviously, such a process will do no more than produce coal gas rich in methane, a very useful asset to the gas industry, but not of great interest to the chemical industry, since methane is a gas which not even the petroleum research chemists have yet discovered to be a suitable raw material for a range of organic chemical manufacture, being in point of fact singularly intractable. The production of liquid methane, by this and allied processes, as a fuel for the internal combustion engine, is visualised.

The synthesis of liquid hydrocarbons from CO and H_2 by the Fischer-Tropsch and allied processes is of importance to the gas industry because the raw material is gas, whether dealt with as such as manufactured from coke or coal. The process is operated at 175-220° C., either at normal or at medium pressure. Dr. King adds, regarding this process: "To the gas industry the methane would be valuable as a bottled gas of high calorific value. The C_3 and C_4 gases could be used similarly or as a source of chemical products. The motor spirit is of low octane number, but the diesel oil is the best known. Perhaps the greatest value of the process, however, lies in the possibility of treating the primary products so as to produce from them products suitable for the chemical industry. I visualise this process in the gas industry as one which could be used to balance the production of coke and gas, and to provide for treatment elsewhere a preparation of raw material suitable for chemical industry." When to this possibility is added the hint given by Colonel Bristow a short while ago (THE CHEMICAL AGE, May 8, 1943, p. 503) that ethylene is produced in considerable quantities by the low-temperature carbonisation of coal, it is evident that, although we may not yet have a complete solution of the problem of providing aliphatic raw materials for the chemical industry, considerable progress is being made and is likely to be more rapid as the work of the Gas Research Board and B.C.U.R.A. gets going.

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NOTES AND COMMENTS

Not Oil versus Coal

PROPHETS who predict imminent exhaustion of supplies of petrol, coal, fixed nitrogen and other vital materials are liable to meet with a very cold reception. Dismiss them as "crying wolf," and one can proceed with the reckless exploitation of irreplaceable reserves as carefree as a sleep-walker nearing a precipice. Fortunately for world civilisation, however, there are other men who sleep less soundly; they see the challenge inherent in such predictions and strive to forestall oncoming shortages by developing new techniques. It is to scientists of this type that we must turn for the realistic, technical answer to the warnings of Mr. Ickes and others about petrol supplies. Up till now the coal and petrol interests have not had much in common, but the world at large is beginning to realise that resources of both materials are not limitless, and it will grow to demand that both coal and oil be put to the best possible uses. That demand will intensify until extravagant uses of either material will be no longer tolerated. Conservation of fuel resources by collaboration must forestall exhaustion by competition. We welcome the view expressed in the last issue of the Petroleum Press Service bulletin that the two fuels are to be regarded rather as allies than as rivals. The bulletin goes on, nevertheless, to minimise the urgency of the petrol supply question, by seeking to explain that exploration work to find new oilfields has been restricted by war-time conditions. It also suggests that the production of oil from coal "can be undertaken only for essentially nationalistic reasons," as it is uneconomic. We would point out that were the raw-material shortages that are concomitant with war replaced by complete exhaustion of a particular mineral, then the word "necessity" would need to be substituted for "nationalistic reasons."

Concentration "off the Record"

"MISGUIDED interference" on the part of certain Government departments is the cause of a complaint by Mr. R. B. E. Jackson, chairman of the Paint Manufacturers and Allied Trades

Association, in a recent letter to *The Times*. It is well known that a deputation of "small" paint manufacturers, received last November by Captain Waterhouse, Joint Parliamentary Secretary to the Board of Trade, put up so strong a case that the Board of Trade subsequently issued a memorandum deciding not to proceed with the compulsory concentration of the industry. Despite this, certain other Government departments, to whose care the paint industry has been handed over, have issued a list of 138 "privileged" firms in the industry, out of a gross total of over 500, and have threatened to divert the labour of the non-privileged majority to other Government work or to augment the staffs of the privileged concerns. It is generally admitted—indeed, it is the declared policy of the Government—that small firms should have equal rights with large in the allocation of Government orders; and many of us fondly believe that it is part of the duty of the Government to protect the ordinary citizen from the dangers of monopolies. Yet the action complained of by Mr. Jackson bids fair to institute a monopoly in an industry where none is wanted, and where certainly none would be desirable. This is not the first instance that has come to our notice where lack of inter-departmental co-ordination has tended to nullify the wishes of the Government, as publicly expressed. It is to be hoped that the Board of Trade will quickly take the action necessary to scotch this anomaly.

American Synthetic Rubber

NOTABLE progress towards realisation of the United States Government's huge synthetic rubber programme is reported by the Rubber Administrator. Of the 84 separate units making up the 48 plants included in the programme, 27 are in operation or ready for operation. The completed plants have a capacity of 252,000 long tons or 30 per cent. of the projected total. In addition, 14 per cent. of the butadiene programme and 18 per cent. of the styrene programme are in operation. Actual production of synthetic rubber in the first three months of the current year amounted to 10,478 long tons, not far

below the estimate of 11,200 tons. By next year it is expected that all the planned synthetic rubber plant will be in operation, providing more than 750,000 tons of crude equivalent. This supply is expected to be supplemented by at least 74,000 tons of imported natural rubber. The nation's total requirements for this year are placed at 609,000 tons, showing no substantial change from earlier estimates. The Administrator points out that by 1944 the United States will have gone for two years with less than a quarter of the normal replacement of tyres and with no new cars. This accumulated deficit is taken to indicate a probable minimum replacement need of 30 million tyres, even with the continuance of present conservation measures. Meanwhile questions are being asked in the British Houses of Parliament as to what is the official attitude here towards domestic production of synthetic rubber. No figures are forthcoming, but it is quite evident that we are "not in the same street" as America.

The Norwood Report

THE dependence of modern civilisation on science and technology has created a condition demanding a sufficient flow of trained scientific workers to maintain the technical standards of our way of life. It is also essential to the stability and harmony of the community that those who are not themselves scientific workers should know something of the aims and methods of scientists, and have some conception of the material power which technology puts into their hands. Any scheme of educational reform must make provision for those needs. It was with some interest, therefore, that we read the report of Sir Cyril Norwood's committee on the curriculum and examinations of secondary schools, having noted that such bodies as the Institutes of Chemistry and Physics had submitted their views to the committee. The report recommends the wider teaching of "General Science" as a subject providing the best introduction to science and capable of creating "an attitude of mind which is ready to accept as Natural Science observation and discussion about rocks and stars, sea and seasons, food and machinery, air and animals." Having dealt thus alliteratively with the manner of introducing science to school-

children, the committee then concentrates all its attention on the student who is to adopt science as his or her vocation. It finds that the universities set scholarship papers at a standard "comparable with a Tripos paper of twenty years ago," and that candidates for these examinations are therefore forced to absorb detailed knowledge which would be better reserved for the university course.

Scientists and Non-scientists

BEARING in mind that the character of sixth-form studies is largely determined by the requirements of examinations, we agree that these examinations must be "remodelled on lines which will demand less factual knowledge, but a surer grasp of principles and method." (We have thought so ever since we found one year's practical examination for a Cambridge entrance scholarship including sodium cobaltcyanide, which the examiners evidently considered a suitable "spot" for youths of 18 to analyse qualitatively!) Beyond these views on "General Science" and university scholarships the committee seems to have little to say about science teaching. It does not appear to have reached a final conclusion as to whether the rest of the Sixth Form—Modern, Classical and History—should continue their scientific studies, or drop them altogether. In view of the fact that the gap existing between the world of science and the world of affairs is too wide, and that administrators and executives know all too little about the scientific techniques which shape our world, we feel that the committee should have found time to make some observations on the problem of presenting, by education, the widening of that gap. Scientific bodies might well accept it as their duty to call attention to this omission and help to remedy it. Since the above paragraph was written, news has come to hand of a resolution on the part of the three chartered chemical bodies, acting in conjunction with educational associations, to set up a Chemistry Education Advisory Board with the special aim of educating chemists in chemistry, as distinct from educating the public concerning chemistry. We look forward with interest to the establishment of the Board in actual fact.

Hydrogen Sulphide Removal, II

Recovery of Sulphur from Commercial Gases

by D. D. HOWAT, B.Sc., Ph.D., F.I.C., A.M.I.Chem.E.

[Continued from THE CHEMICAL AGE, July 24, p. 78.]

OTHER liquid purification processes, unlike the Seaboard, aim at the recovery of the sulphur from the gases and may be divided into two groups, *viz.* (a) those in which elementary sulphur is produced and (b) those in which gaseous hydrogen sulphide is recovered. Of group

sodium thioarsenate $2\text{Na}_2\text{HAsO}_3 + 5\text{H}_2\text{S}$
 $= \text{Na}_4\text{As}_2\text{S}_5 + 6\text{H}_2\text{O}$ (i)

(ii) The sodium thioarsenite, absorbing oxygen from the air, produces thioarsenate: $\text{Na}_4\text{As}_2\text{S}_5 + \text{O}_2 = \text{Na}_4\text{As}_2\text{S}_5\text{O}_2 \dots$ (ii)

(iii) Thioarsenate formed as indicated is the Thylox compound in the normal

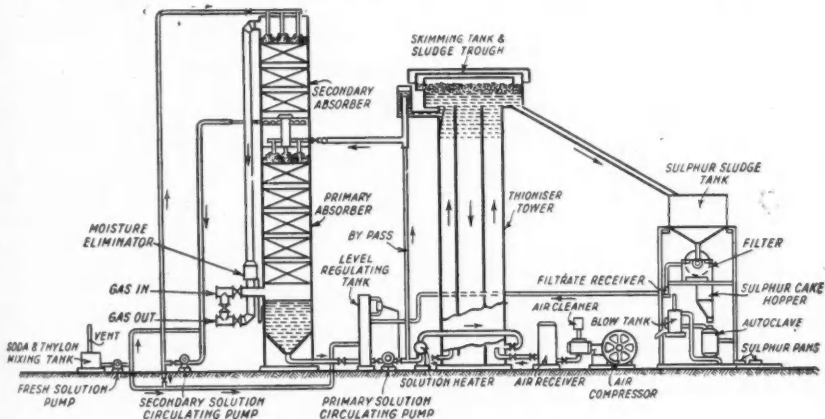


Fig. 1. Flow diagram of the two-stage Thylox process.

(a) by far the best known is the Thylox process, developed by the Koppers Company, of U.S.A. In this process the hydrogen sulphide is scrubbed from the gases by a solution of sodium or ammonium thioarsenate, which is regenerated by compressed air. Oxygen from the air, dissolving in the thioarsenate solution loaded with the hydrogen sulphide, oxidises the latter, producing elementary sulphur in a very finely subdivided condition. The air current through the solution lifts the particles of sulphur to the surface as a froth which overflows a weir and is treated for the extraction of the element.

According to Gollmar¹⁰ the following reactions are involved: (i) the absorbing solution is made up by dissolving sodium carbonate and arsenious oxide in water. The compound first formed, sodium arsenite, is a very active absorbent for hydrogen sulphide, forming

absorption and regeneration cycle:
 $\text{Na}_4\text{As}_2\text{S}_5\text{O}_2 + \text{H}_2\text{S} = \text{Na}_4\text{As}_2\text{S}_6\text{O} + \text{H}_2\text{O} \dots (\text{iii})$

During regeneration the solution absorbs oxygen from the air, causing the following reaction: $\text{Na}_4\text{As}_2\text{S}_6\text{O} + \text{O} = \text{Na}_4\text{As}_2\text{S}_6\text{O}_2 + \text{S}$ (iv)

In the Thylox process, as originally designed and operating on a single stage, removal of the last traces of hydrogen sulphide was not easily effected. To increase the efficiency of the removal and to make use of the very pronounced absorption of hydrogen sulphide in reactions (i) and (ii), a two-stage Thylox process has been devised to allow these reactions to take place in a secondary stage. The solution in which the required make-up additions of soda ash and arsenious trioxide are dissolved is first brought into contact with the exit gases from the primary absorption stage;

90-95 per cent. hydrogen sulphide removal is effected in the primary stage, the make-up solution with high absorptive power extracting the remaining traces of the gas. The exit gases from the secondary stage are "clean to lead-acetate paper," containing less than 0.2 grains hydrogen sulphide per 100 cu. feet.

The Thylox Process

The absorption tower is composed of two portions, the lower larger portion constituting the primary absorber and the upper smaller portion the secondary absorber. Between the two portions is a balcony or recess in which is located a header feeding the solution distribution sprays. The gas to be purified enters at the base of the tower, passing upward counter-current to the solution flowing downward over the wooden hurdles which constitute the tower packing. From the base of the absorption tower the solution is pumped to the base of the regeneration tower or "pressure thioniser." Built in the form of a cylindrical steel shell, the regenerator is divided vertically into three compartments, devoid of packing. Introduced at the bottom of the first compartment, the solution passes upward, overflowing into the second, through which it descends. Flowing under a partition, the solution is forced upward through the third compartment, overflowing at the top into a pipe feeding the absorption tower sprays. Compressed air is blown into the base of each compartment, oxidising the hydrogen sulphide and carrying up the finely divided sulphur particles to the top of the tower as a froth. The light froth of sulphur overflows a weir and is fed to the slurry tank and thence to the settling and filtration plant for recovery of the sulphur. The exit gases from the primary absorption stage pass through a throat in the centre of the balcony to the secondary absorber, where they contact the "make-up" arsenite solution. The last traces of hydrogen sulphide are removed, the "make-up" solution overflowing a dam at the bottom of the chamber and joining the main absorption solution. The volume of "make-up" solution is regulated to compensate for the losses in the primary system of absorption and regeneration.

Ammonia is frequently used in place of soda ash as the alkaline radical, with

the attendant advantage that one pound weight will produce the same alkalinity as 3 lb. of soda ash, while the reagent may be added in the gaseous phase by passing the required amount of weak solution through the saturators. Powell¹¹ gives the following figures of operating data in the two-stage process. The temperature in the regenerator should be maintained at about 35° C., steam being required in cold weather.

	Primary Stage.	Secondary Stage.
Rate of circulation (gall. per 1000 cu. ft.)	50 to 200	50
Arsenious trioxide in absorption solution (per cent.)	0.3 to 1.0	1.30 to 2.0
pH of absorption solution	7.6 to 8.0	8.0 to 10.0
Consumption:—		
Arsenious oxide (lb. per 1000 cu. ft.)	0.003 to 0.010	
Soda ash (lb. per 1000 cu. ft.)	0.050 to 0.120	
Compressed air (cu. ft. per 1000 cu. ft.)	40 to 100	
Steam (lb. per 1000 cu. ft.)	0 to 5	
Sulphur recovered as brimstone	60/85 per cent. of original gas content.	

Consumption of the reagent arises from two causes, first, the formation of thio-sulphates and, second, combination with hydrocyanic acid to form thiocyanates. The sulphur absorbed in these side-reactions is not recoverable but, particularly in gases with a high hydrocyanic acid content, the loss of sulphur is more than offset by the removal of this constituent.

The Thylox process, which has been widely adopted in Germany and elsewhere, is claimed to be one of the cheapest purification processes available. Published results¹² show gross operating costs of less than $\frac{1}{4}$ d. per 1000 cu. ft., with a reduction to about $\frac{1}{8}$ d. when credit is allowed for the recovered sulphur. The disadvantages of the process are that it is not suitable for the treatment of (1) high-pressure gases; (2) gases carrying over 500 grains of hydrogen sulphide per 100 cu. ft.; (3) gas containing tar or light condensable oils—these seriously interfere with the regeneration stage.

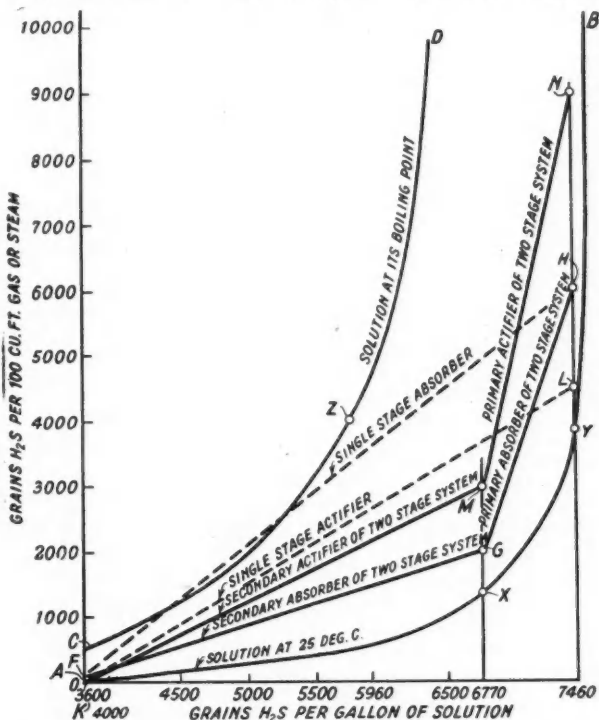
The more recently developed processes in group (b), in which the gaseous hydrogen sulphide is recovered, aim at the treatment of high-pressure gases, such as refinery and natural gases. Regeneration is effected by steam, which affords the necessary heat while mechanically sweeping the hydrogen sulphide from the solution. Steam in the exit gases is condensed so that high-purity hydrogen sulphide is obtained. All the commercial-scale processes are two-stage, giving a 98-99 per cent. removal of hy-

drogen sulphide. The absorption solutions in use may be classified as follows: (a) phenol derivatives (e.g., Koppers Phenolate process); (b) organic amines

the regeneration stage. (3) The electrolytic dissociation constant of phenol (1.3×10^{-10}) is less than that of hydrogen sulphide (5.7×10^{-8}) at room tempera-

Fig. 2.—Curves showing relations between partial pressures of H_2S and H_2S content of phenolate solutions existing in the absorption and regeneration conditions.

AB = Vap. press. of dissolved H_2S over phenolate solution (4 mols. NaOH and 2.5 mols. phenol per litre) at 25°C.
CD = Vap. press. of dissolved H_2S over this same solution at boiling point.
Other curves = Operation of single and double stage absorbers and regenerators.



(e.g., Girbotol process); (c) potassium phosphates (e.g., tri-potassium phosphate process).

Phenol Processes

(a) The improvements claimed in the use of sodium phenolate as the absorption medium for hydrogen sulphide are: (1) it is a salt of a strong base and a weak acid (phenol); (2) the molecular heat of electrolytic dissociation of phenol (-6100 cal.) is almost identical with that of hydrogen sulphide (-6060 cal.). This fact indicates that, like hydrogen sulphide, the acidity of phenol increases with rise in temperature. Phenol, however, is not nearly so volatile as hydrogen sulphide and will therefore tend to "crowd out" the latter component at the higher temperatures characteristic of

the regeneration stage. (3) The electrolytic dissociation constant of phenol (1.3×10^{-10}) is less than that of hydrogen sulphide (5.7×10^{-8}) at room tempera-

In consequence, hydrogen sulphide will easily replace phenol at the temperatures characteristic of the absorption stage. (4) Phenol has only a limited solubility in water, therefore the phenol displaced during absorption forms a separate liquid phase. This reduces the activity of the phenol as an acidic constituent, allowing easier absorption of the hydrogen sulphide. The reverse action takes place during regeneration, the phenol re-entering the aqueous phase and thereby enhancing the displacement of hydrogen sulphide. (5) The ratio of phenol to caustic alkali may be varied over quite an extensive range, permitting great flexibility in the choice of solution composition for any given set of operating conditions.

In discussing the Phenolate process,

Carvlin¹³ points out that the partial pressures of hydrogen sulphide in solutions of sodium phenolate do not conform to Henry's Law and the vapour pressure curves, as shown in Fig. 2, are strongly bowed. Actual operating conditions for both absorption and regeneration are evident from a study of the curves, and operations should be so arranged that the conditions actually obtaining will approach as closely as possible to the vapour pressure curves of the solution at about 25° C. for absorption and at the boiling point for regeneration. With the strongly bowed curves characteristic of the hydrogen sulphide/sodium phenolate equilibrium, it is obvious that at least a two-stage process will be required. Otherwise the divergence between the equilibrium curve and the actual operating conditions becomes steadily increased. Particularly in the regeneration stage this involves the employment of excessive quantities of steam to effect the displacement of the hydrogen sulphide. Increased efficiency and economy in steam consumption are effected by employing a two-stage process both for absorption and regeneration. The two lines representing the two stages join at angles which make them approach more closely the curve of the vapour pressure of the solution.

In the two-stage phenolate process, as illustrated in Fig. 3, the gas enters the absorber at the base, passing upward through a series of bubble-cap trays counter-current to the flow of regenerated phenolate solution, the purified gas leaving from the top of the absorber. The phenolate solution from the primary-stage regeneration is fed to the middle of the absorber tower, being employed to scrub the greater part of the hydrogen sulphide from the entering gases. The phenolate solution from the secondary regeneration stage enters the absorption column at the third or fourth tray from the top and during its downward passage eliminates the last traces of hydrogen sulphide from the gases. A very small quantity of fresh water is introduced continuously on the top tray to scrub out and wash back to the solution any chemicals entrained in the cleaned gases.

Flow of the scrubbing solution from the base of the absorption tower to the top of the regenerator may be accomplished either by pumping or by the pressure of the gas in the absorber. The solution passes down through the regenerator counter-current to a flow of steam generated by a reboiler in the base. The hydrogen sulphide released in the regenerator passes through a dephlegmator,

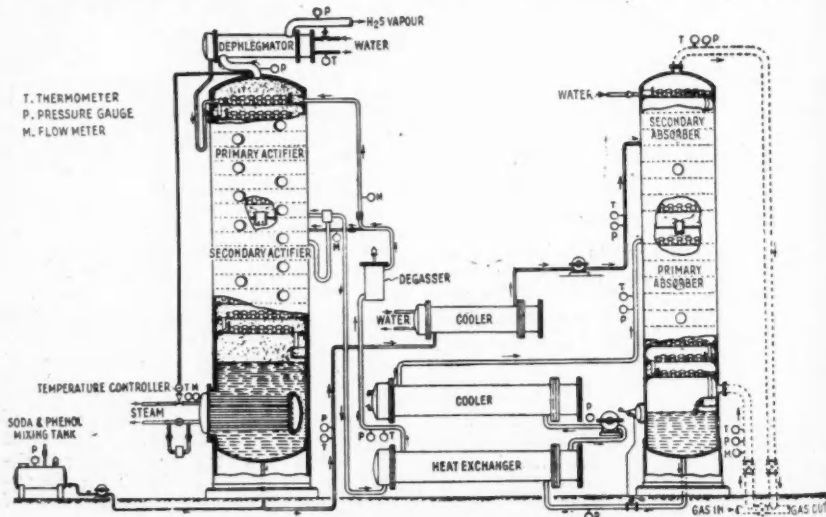


Fig. 3. Flow diagram of two-stage Phenolate process.

where the accompanying steam is condensed and the condensate returned to the regenerator column. The upper part of the column forms the primary regeneration stage, the greater part of the solution being withdrawn at a point halfway to the base, whence it is recirculated to the absorber. The smaller fraction of the solution continues down to the base of the regenerator, being brought into contact with an increasingly large quantity of steam, effective removal of the remaining quantities of hydrogen sulphide still held in the solution takes place during this second stage. From the bottom of the regeneration tower the highly regenerated solution is pumped to the top part of the absorber to flow through the secondary absorption stage. From that stage the solution joins the main bulk of the liquid return from the regenerator and flows down to the base of the absorber from which it is recycled to the top of the regenerator. Economy in heating is secured by the use of heat-exchangers in which the excess heat of the regenerated solution is transferred to the solution from the absorber, but in general the regenerated solution must be passed also through a cooler before the temperature is sufficiently low to allow it to be fed to the absorber.

Phenolate Plant Performance

At a petroleum refinery plant in the U.S.A. a two-stage phenolate plant has a capacity of $16\frac{1}{2}$ million cu. ft. of gas per day, the hydrogen sulphide content of the gas being 2500-3200 grains per 100 cu. feet. Recovery of sulphur at full operation is about 35 tons per day, the hydrogen sulphide being converted into sulphuric acid in a contact-type plant. The gross operating cost is about $\frac{1}{2}$ d. per 1000 cu. feet. With high sulphur content gases the sulphur recovery more than pays for the cost of purification.

A recent modification of this process¹⁴ incorporates a third minor stage. In the condenser for treating the exit gases from the regenerator the condensate is allowed to separate into two layers, a phenol and an aqueous phase. The phenol phase is returned to the regenerator while the aqueous phase passes to a third reboiler in which more phenol is liberated and returned to the regenerator. The aqueous residue from the third stage is employed to scrub the last

traces of phenol from the absorption tower exit gases, the resultant phenol/water phase being returned to the third stage.

The process is very suitable for the treatment of high-pressure gases. The large quantities of hydrogen sulphide frequently associated with natural and refinery gases are easily and completely removed. Commonly the value of the sulphuric acid produced more than covers the total purification costs. The plant is simple and the operation may be made substantially automatic. The steam reboiler may be controlled automatically by the temperature of the vapours leaving the regenerator. The water feed to the dephlegmator or condenser is controlled by the temperature of the exit gases. Additions of phenol are required only at intervals of several weeks.

Organic Amine Processes

(b) The best known of the commercial processes using organic amines is the Girbotol process, the basic reaction involved being: $RNH_2 + H_2S = RNH_3HS$ (R=organic radical.) As described by Wood and Storrs,¹⁵ the plant operates on the normal absorption and regeneration cycle, together with the necessary reboiler, heat exchangers, and coolers. The gas enters at the base of the absorber, a bubble-plate or packed tower, flowing upward counter-current to the stream of amine solution which is fed near the top. The purified gas escapes at the top of the tower, while the absorbing solution is fed either through a pump or by the pressure in the absorber through a heat-exchanger to the top of the regenerator. If the pressure of the gases is very high, a flash drum may be inserted between the absorber and the heat exchanger to release hydrocarbons dissolved in the solution at the high pressures. Made in the form either of a bubble-plate or a packed tower, the regenerator contains a reboiler located in or near the base. Steam generated by the reboiler flows upward through the solution, expelling the hydrogen sulphide. The boiling solution from the base of the regenerator is pumped through a heat-exchanger, thence to a solution cooler, and finally returned to the top of the absorber.

The hydrogen sulphide and steam flow together from the top of the regenerator to the cooler, where the temperature is

reduced to atmospheric, while the condensate returns to the top of the regenerator. The hydrogen sulphide passes to the acid plant. Four plants have been erected for the treatment of refinery

(2) Mechanical and volatilisation losses of the ethanolamine are low, usually about 0.1 lb. per million cu. ft. of gas treated.

(3) The plant may be made almost

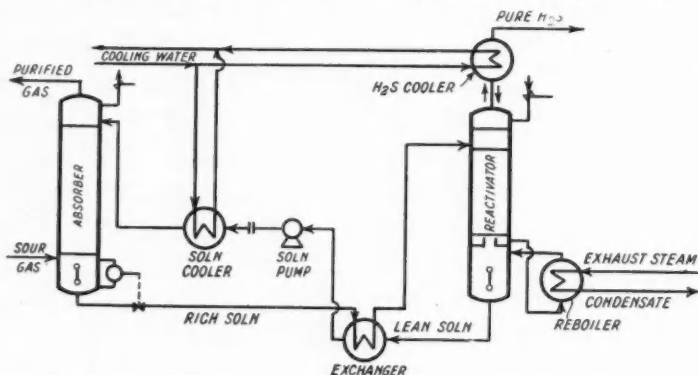


Fig. 4.—Flow diagram of the Girbotol organic amine process.

gases and seven for purifying natural gas, the daily capacity of these plants varying from $\frac{1}{2}$ to 40 million cu. feet. A diagrammatic lay-out of a typical plant is shown in Fig. 4.

A number of advantages are claimed for this process:—

(1) The absorption solution consists of a single definite compound so that accurate chemical control of the solution, including pH determination, is not necessary, while no corrosive action occurs.

completely automatic in operation by the use of suitable control equipment.

(4) Purification costs are low, between $\frac{1}{4}$ d. and 1d. per 1000 cu. feet.

(5) Carbon dioxide is easily removed from the gases in addition to hydrogen sulphide.

Tri-potassium Phosphate Process

(c) A reversible reaction occurs between hydrogen sulphide and tri-potassium phosphate, as follows: $K_3PO_4 + H_2S =$

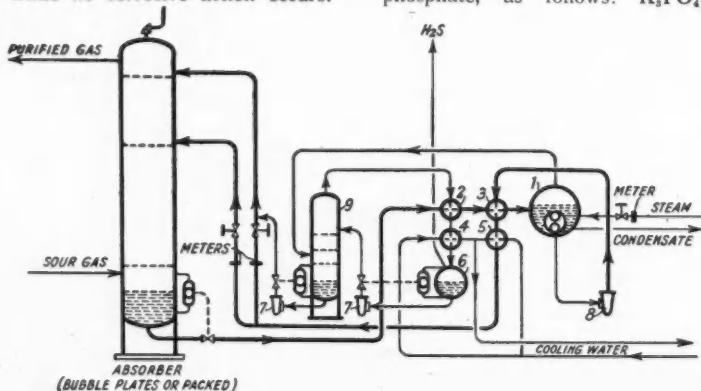


Fig. 5.—Shell (or tri-potassium phosphate) process flow chart, for use where an extremely high degree of purification is necessary. 1. Reboiler type regenerator. 2. 3. Exchangers. 4. Condenser. 5. Solution cooler. 6. Condensate accumulator. 7. Condensate pumps. 8. Solution pump. 9. Condensate stripper.

$K_2HPO_4 + KHS$, the hydrogen sulphide being released at the boiling point of the solution. The usual cycle of absorption and regeneration processes obtains, the absorption solution containing from 40 to 50 per cent. by weight of tri-potassium phosphate.

Typical Phosphate Plant

As shown in the flow-sheet in Fig. 5, the plant comprises an absorber or the conventional bubble-plate or packed tower, a standard reboiler heated with exhaust steam, together with the necessary heat-exchangers, solution coolers and pumps. Although considerable volumes of steam are required for regeneration, good heat economy is rendered possible by the use of exchangers on the solution passing to and from the regenerator.¹⁶ The absorption solution is prepared on site by mixing commercial grades of potassium hydroxide and phosphoric acid. The salt is non-volatile, losses being confined to packing-gland leakage on the pumps.

The Effect of Dilution

The equilibrium vapour-pressure of hydrogen sulphide over tri-potassium phosphate solution for a given hydrogen sulphide concentration is greatly reduced when the solution is diluted with water. This reduction in the equilibrium vapour-pressure with reduced tri-potassium phosphate concentration is peculiar to the phosphate process, and advantage is taken of this fact to develop a system of split-solution flow in the absorber. The equilibrium pressure conditions for hydrogen sulphide in contact with a 50 per cent. tri-potassium phosphate solution are shown in Fig. 6. The great bulk of the 40-50 per cent. phosphate solution from the regenerator is fed to the absorber at a point some distance from the top. This concentrated solution, contacting the inlet gas, absorbs the larger proportion of the hydrogen sulphide. The dilute solution required to effect the removal of the residual traces of hydrogen sulphide is a mixture of the condensate from the reboiler with a small percentage of the regenerated solution, the proportions of the two being adjusted to give the required phosphate concentration of about 20-25 per cent. The dilute solution is pumped to the

top of the absorber and brought into contact with the exit gases from the primary stage of absorption. Leaving the secondary stage, the dilute solution joins the main bulk of the absorption solution. In this manner very complete absorption of hydrogen sulphide may be obtained without the necessity of regenerating the total bulk of the solution to the lower degree of hydrogen sulphide

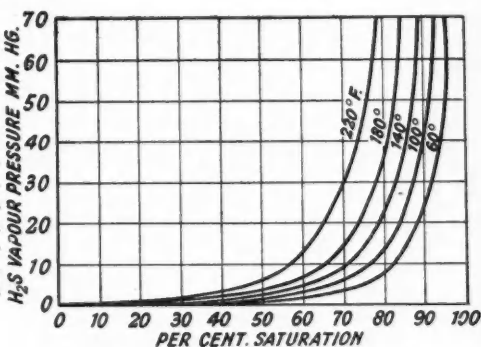


Fig. 6.—Equilibrium pressure of hydrogen sulphide over 50 per cent. tri-potassium phosphate solution.

saturation required for the low concentration in the cleaned gas. Several plants are in commercial operation in the U.S.A. Among the advantages claimed for the process are: (1) it may be used for treating gases up to 200° F.; (2) it is economical in the low cost of the reagents and in small solution losses; (3) the solutions are non-corrosive to steel; (4) the plant is simple to erect; (5) chemical control is easy.

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Parliamentary Topics

Synthetic Rubber in Britain

IN the House of Commons last week Mr. Shinwell asked the Minister of Production whether he could make a statement on the progress of investigations into the production of synthetic rubber in this country; and whether any proposals had been made to him on the subject by British firms. Mr. Garro Jones replied that the Synthetic Rubber Committee had kept the question under review and a number of proposals for the manufacture of synthetic rubber and various rubber substitutes had been investigated. Substantial supplies of synthetic rubber were expected from the United States, and no decision had been made to produce synthetic rubber in bulk in Great Britain. Certain suggestions for production in this country had been communicated to Mr. Shinwell by a British firm and that firm had been asked for further information in regard to their proposals.

Mr. Shinwell: Is it not true to say that the British firm referred to in both the question and the answer have made a firm offer to the Minister of Production that they are ready to instal plant and all that is required to enable the country to produce synthetic rubber is the consent of the Minister, and why should we not produce it here instead of allowing this important commodity to be produced elsewhere?

Mr. Garro Jones said he believed it was perfectly true that the firm were confident that they could produce synthetic rubber, but Mr. Shinwell must obviously satisfy himself that their confidence was well founded. With regard to the second question, the answer was that substantial supplies were expected from the United States, and there was good reason to believe that expectation would not be disappointed.

Imperial Chemical Industries

In reply to a question by Mr. Barstow as to whether I.C.I. had informed the Government at the beginning of the war that their international agreements had been declared null and void, Captain Waterhouse stated that commercial agreements with foreigners were frustrated and illegal by the ordinary operation of law when the foreigner became an enemy, and no formal declaration of nullity was required; but I.C.I. had informed the Government at the beginning of the war that their cartel agreements with persons who had become enemies were regarded as dissolved.

Mr. Burke asked the President of the Board of Trade why the plant, together with the goodwill and processes, of the German-owned firm known as Albert Products, Ltd., manufacturers of synthetic ingredients for lacquers and paints to the

patents of Dr. Albert, which was taken over by the Custodian of Enemy Property, was sold to I.C.I. and not offered for sale to the trade in general. Mr. Dalton replied that the factories of Albert Products, Ltd., were burnt out as a result of enemy action and were unable to resume production. The decision to sell the business was known in the trade, since inquiries from a number of firms were received, but the Custodian of Enemy Property, who also himself approached others, considered the offers made by I.C.I. were the best and therefore accepted them.

Mr. Shinwell: Do you not appreciate that this transaction is increasing the monopolistic powers of I.C.I., which may constitute a very grave menace to the State? Mr. Dalton: That is a large question, which can be debated on another occasion. The decision of the Custodian of Enemy Property, he said, had been taken after consultation with the Supply Ministers.

British Firms and Cartels

Mr. J. Griffiths this week asked the Prime Minister whether he would consider the desirability of ensuring that, after the cessation of hostilities, no British firm or association of firms should enter into arrangements, or join a cartel or similar organisation with British or foreign firms or associations, for the purpose of restricting production, the fixation of prices, or allocation of markets without the prior consent of the Government; and that the terms of any such arrangement should be laid before Parliament for approval before it became operative. Mr. Churchill, in a written reply, said that the question was already receiving consideration.

Conversion of Oil Furnaces

Sir R. Tasker asked the Minister of Fuel and Power whether owners of plant using oil for heating purposes were required to convert their furnaces to use coal, and whether a contribution towards the cost of conversion would be made by the State.

Major Lloyd George said that consumers of imported oil, both for heating and industrial purposes, had been required to convert their plants to use available home-produced fuels. Until recently these conversions had been confined to relatively large oil consuming plants and mainly to creosote/pitch mixture. The increased demands of the Services for oil made it necessary that smaller consumers should convert their plants wherever practicable to use coke or anthracite. He regretted that it was not possible to make any contribution towards the cost from public funds.

Leather Trades Chemists

London Symposium on War-Time Problems

A MEETING of the British Section of the International Society of Leather Trades Chemists was held on July 16-17 at the Imperial Hotel, Russell Square, London, W.C.1, and took the form of a symposium on "Present-Day War-Time Problems." Dr. D. Burton, acting president of the section, was in the chair, and there was a record attendance.

In his paper on "Some War-Time Research Problems," Professor D. McCandlish mentioned researches carried out in the Leather Department of Leeds University and mentioned the possibilities of aluminium retanning of vegetable leather instead of the usual semi-chrome. The process had been tried out on E.I. tanned kips, which after long storage showed no signs of deterioration. He also referred to chrome-iron combination tannage, saying the work done to date confirmed some earlier tests recorded by American workers. He discussed the use of liquid fatty acid soaps for fat-liquoring, the advantages of these soaps over those of the solid fatty acids such as stearic and palmitic being indicated. The oleate served both as a neutralising agent and a lubricant, the oleic acid being liberated *in situ*. The oleic acid used should contain only very small amounts of solid fatty acids. Devitaminised cod oils could be used for chamoising, and the suitability of a cod oil for the purpose could be determined by studying its action in the Mackay Oil Tester when used under certain conditions.

Elasticity of Leather

Dr. Dorothy Jordan Lloyd, director of the British Leather Manufacturers' Research Association, described how research had shown the close connection between the physical properties of leather and the micro-structure of the hide or skin, certain properties being due to the transverse properties of the collagen fibres, others to the longitudinal properties, others to the compactness or looseness of the fibre weave, and others again to the size and total volume of air spaces in between the fibres. The elasticity of leather, however, was not a fundamental property of the collagen molecules, since Astbury had shown that there was practically no elastic extension in these. The elasticity of leather came from the permanent set given to the collagen fibres during tanning. The fibres were set to the right angle of weave by the pre-tanning processes, and fixed in this form during the tannage. The elasticity of leather was similar to the elasticity of a

spring made by coiling an iron wire. The correct proportion of elastic and non-elastic stretch in any particular leather depended on the purpose for which it was required. The "handle" or "feel" of leather also came from the physical properties of the fibres. The softness or stiffness of any leather, for instance, depended on the run of the fibres, all leathers being softer and less springy if folded over parallel to the main run of the fibres.

Mr. G. H. W. Humphreys described the tannery chemist's part in the war effort. He said the production of sole leather had been examined process by process to see where economy in labour could be effected. Suggestions to this end had included the total elimination of the soaking process for all classes of hides so that they would be put straight into lime. The liming process also could be mechanised to save labour.

Mr. J. Hill spoke on "War-Time Problems in the Shoe Industry." He said that partially successful attempts had been made to find alternative soling material by using scrap sole leather which was disintegrated, mixed with a binder and converted into sheet form. The production of an adhesive with the desired property of immediate adhesion was being investigated, and there were hopes that one would be found among the large range of synthetic resins now available. It was becoming almost a habit in most industries to look to plastics to provide an answer to any given problem and, though it was realised that plastics had their limitations, there seemed considerable scope for them in the shoe industry, so much so that one could easily envisage the time when a complete plastic shoe would be an accepted article of commerce.

During the section's business meeting the acting president referred to the growth of the British Section since 1922, the formation of local groups of the Section, and the work of the Colorimetric Committee. He also referred to the proposed formation of a Technical Advisory Committee and the re-organisation of the various sub-committees, all designed to give greater scope for members and associates to participate in the work of the Society, and to improve the working efficiency of the Section.

The Trading with the Enemy Orders in respect of Madagascar, French Somaliland, Reunion, Algeria, Tunisia, and the French Zone of Morocco are revoked, as from July 15, by S.R. & O. 1943, Nos. 821 and 822, issued by the Board of Trade.

Chemical Treatment of Textiles

Water and Moth Repellents

MANY new techniques for rendering fabrics proof against water, moths, and mildews have been worked out by textile chemists since the war began; and afterwards, when the necessary raw materials become available. It is certain that several of the patents which cannot be exploited at present will come into general commercial practice. The June *Journal of the Textile Institute* gives details of several such processes. U.S.P. 2,287,896 describes how halogenated aminosulphonic acids of the benzene series (e.g., 3:4-dichloroaniline-6-sulphonic acid or 3'-aminobenzoyl-3:4-dichloroaniline-6-sulphonic acid) are acylated by reacting with *p*-chlorobenzoyl chloride or bromide, 3:4-dichlorobenzoyl chloride, *p*-chlorophenylacetyl chloride, or mono- or di-chloro- or bromobenzoyl halides to form mothproofing compounds. Other mothproofing agents include colourless triazine condensation products prepared by causing a cyanuric halide to react, in the presence of an agent which binds halogen acid, e.g., an acetate or carbonate, with amino sulphonic acids or amines containing reactive hydrogen. (U.S.P. 2,288,971.) Repellent to moth larvae are the sodium and potassium compounds formed by reacting a saturated solution of guanidine carbonate with a saturated solution of sodium or potassium ferrocyanide, and the ammonium compound formed by reacting the di-sodium compound in saturated solution with ammonium carbonate used in excess, are used as moth larvae repellents. Other guanidine salts, e.g., the hydrochloride and nitrate, may also be used. (U.S.P. 2,289,547.) A Swiss mothproofing patent (Swiss P. 213,703) uses the condensation product obtained by reacting 1 mol. cyanuric chloride with 1 mol. sodium methylate, 1 mol. 4-amino-1:1-diphenyl ether-2-sulphonic acid and 1 mol. 3'-methyl-4-amino-1:1-diphenyl ether-2-sulphonic acid, the product then being chlorinated.

Chlorination Process

Production of a cellulosic fabric which is fire-, water-, and mildew-proof, is claimed in U.S.P. 2,299,612. The fabric is impregnated with a chlorinated oil or rubber (20-70 per cent. chlorinated) that would involve chlorine gases at the firing temperature, and a substantial proportion of the oxide or sulphide of As, Sb or Bi, a plasticiser, a volatile solvent, and an opaque material that serves to protect the chlorinated component from the light. General Aniline & Film Corporation have patented a process

for rendering textiles water-repellent by impregnation with a liquor containing a quaternary ammonium salt of the formula $R.X.CH_2.O.CO.R_2.NZ$ Hal. or $R_1.X_2.CH_2.O.CO.R_2.NZ$ Hal. and drying; R is an aliphatic, cycloaliphatic or heterocycloaliphatic grouping of at least 11 C atoms, R_1 is alkyl, X is O,S, -CONR₃- or -OCONR₃-, R₂ is H or alkyl, R₃ is a lower alkyl or lower halogenated alkyl group, and NZ is an N-alkylated pyrrolidine, piperidine, or morpholine system, or a tertiary aliphatic or heterocyclic amine (U.S.P. 2,301,676). Another water-repellent impregnation depends on the use of the reaction product of hexamethylenetetramine and a fatty acid halide, carbonic ester halide, or carbamic acid halide, dried and heated (U.S.P. 2,301,352).

A NEW SULPHONAMIDE

An important development in the field of sulphonamides is reported from the United States, through *Chem. and Eng. News*. The new drug, known as sulphamerazine, has been developed at the Medical Research Laboratories of Sharpe and Dohme, at Philadelphia. Chemically speaking, it is 2-sulphanilamido-4-methyl pyrimidine, and is related to the widely used sulphadiazine. It is less expensive to manufacture, however, and it is claimed to be equally efficient, in smaller doses; e.g., in certain diseases where four to six daily doses of sulphadiazine are required, one to three doses of sulphamerazine are sufficient. It would thus appear to be particularly appropriate for use under battle conditions. It is also said to be more rapidly and completely absorbed into the system than is sulphadiazine, and is less rapidly excreted.

LEAD-COATED SHEETS

A lead-coated steel sheet is being produced by the Continental Steel Corporation, of Kokomo, Indiana, after 18 years of experiment. It is claimed that this new "Lead-Sealed" sheet has many advantages: it "takes" and "holds" paint and fine finishes without preparatory treatment or weathering; the sheets have proved excellent for die-forming, as the lead acts as a lubricant to the die, and does not crack or peel, and, since lead has a comparatively low melting point, it lends itself well to application on sheets that must possess ductility or uniformity of temper. Another advantage of the new process is that practically no tin or other critical materials are used.

Science in Agriculture

A Century of Solid Achievement

ROTHAMSTED—or, to give its full name, which is so little used that it has an unfamiliar sound, Rothamsted Experimental Station—celebrated its centenary on July 21. It is the first agricultural station in the world to reach its century. The celebrations took the form of a tour of the Station and a luncheon, which was attended by 300 people, including Mr. R. S. Hudson,

ment of a sound science of plant growth for the use of experts, teachers, and farmers. The laws of nature held true everywhere, and any sound information about them was likely to be just as useful in China as it was in England. For Rothamsted to maintain its high position it needed to attract the best of the younger scientists by giving them good laboratories and the freedom of

At the Rothamsted centenary celebrations, Sir John Russell paid a well-deserved tribute to the assistants who help the research staff. Our photograph shows a young assistant chemist engaged on analytical work.



the Minister of Agriculture, and representatives of 28 nations. Lord Radnor, presiding, spoke of the international fame Rothamsted had achieved, and expressed the hope that its second century would be even more profitable. He said that the Station, and British agriculture as a whole, owed a great debt of gratitude to the retiring director, Sir John Russell. Mr. R. S. Hudson referred to Lawes and Gilbert, the founders of Rothamsted, and suggested it was not inappropriate that the celebrations should be held during a war which might have been lost through starvation but for the work that had been done on artificial fertilisers. A century ago those materials were unknown, and the work of Lawes and Gilbert had done more for world agriculture than any other piece of research, before or since.

Sir John Russell told his audience that parallel meetings were being held in Lisbon, by Portuguese agriculturists, and in Cincinnati, by American scientists. The scientists of Rothamsted were proud of this world-wide recognition of their work, and they were sure that it arose, not because the work had been going on for 100 years, but because it had proved so useful. That was the justification of their aim, which was the develop-

ment of a sound science of plant growth for the use of experts, teachers, and farmers. The laws of nature held true everywhere, and any sound information about them was likely to be just as useful in China as it was in England. For Rothamsted to maintain its high position it needed to attract the best of the younger scientists by giving them good laboratories and the freedom of thought and action which would allow them to develop their subject in whatever direction the experimental results might lead. In 1934, the Rothamsted Estate was in danger of being cut up into building lots, but within a few weeks the Society for Extending the Rothamsted Experiments raised the funds to buy the 530 acres and the historic manor house, so ensuring permanently the undisturbed continuance of the work. The centenary fund provided the money for more and better accommodation, the erection of which had been halted by the war. "Science is not yet as expensive as war but it is getting on that way," he remarked.

Cables of congratulation were received from scientists and agriculturists in Australia, Canada, New Zealand, Palestine, Sweden, and Russia. One message, from a new research station, was aptly addressed to "Grandfather Rothamsted."

The origin of Rothamsted is described by Sir John Russell in a 60-page booklet published to mark the centenary. Lawes's invention of superphosphate—it was with the fortune that he made out of selling this fertiliser that he financed Rothamsted—arose from the chance remark of a neighbouring farmer that bones were good fertilisers on

some soils, but not on others. His experiments showed that bones treated with sulphuric acid succeeded where untreated bones failed. Mineral calcium phosphate was found to be similarly unreactive, but acid treatment made it available for plant growth. He patented the process in 1842 and set up the first superphosphate factory at Deptford Creek, so founding the great artificial fertiliser industry. It was in June, 1843, that Lawes brought in a young chemist, J. H. Gilbert, to continue and develop the experiments already begun. A hundred years ago the experiments comparing the effect of various fertilisers were started on the world-famous Broadbalk Field, and the hundredth crop of wheat is to-day ripening there. The chemical side of Rothamsted is thus the oldest branch of research conducted at the station. Some of the most recent work done in this department is that on new forms of "high temperature" phosphates, such as the T.V.A. calcium metaphosphate, which are yielding promising results.

British Standards Institution

Annual Meeting

AT the annual general meeting of the British Standards Institution, held on July 20, the chairman, Sir Percy Ashley, K.B.E., C.B., welcomed Mr. C. F. Merriam, chairman of The Association of British Chemical Manufacturers, who had accepted the chairmanship of the Chemical Divisional Council in place of Mr. R. Duncalfe. Sir Percy announced that, following the official recognition of the Institution as the sole organisation for the issue of standards having a national application, the Government had decided to increase the grant-in-aid which, during the coming year, would be approximately £12,500, or nearly double the former grant.

A National Organisation

There were in current use to-day about 1500 British Standards, and during the year under review 230 new and revised standards or amendments had been issued.

He added: "I believe that those industries which have been long associated with the Institution recognise fully the advantage of having a single, independent, national standards organisation. But those others which are only now beginning to consider the opportuneness of the time for a standardisation programme may feel that the preparation and promulgation of standards is a matter of purely domestic concern and should therefore be carried out solely by their individual trade associations. There has also been some tendency for Government departments to do standardisation work in their own ways and on their own lines. I believe that both these courses are

wrong in principle, and that the best results will be obtained only if all this work is carried on within a national organisation such as the British Standards Institution which can co-ordinate and guide all such action to a common end."

Increased Distribution

Dr. E. F. Armstrong, F.R.S., the Chairman of the Finance Committee, in presenting the accounts, explained that during the year under review the contributions to the expenses of the Institution amounted to £53,000, an increase of 20 per cent. over the previous year. The distribution of British Standards had gone up 57 per cent.

The Institute of Physics

Annual Report

THE report of the Institute of Physics for 1942 shows that special attention has been given by its board to urgent questions concerning the training and supply of physicists needed for war purposes. The board is able to record with gratification that its views not only coincided in almost every respect with those of the Government's Technical Personnel Committee, but were being embodied in measures that were being taken. A good deal of attention has also been given to considerations concerning the best way of ensuring to intending physicists after the war an education that will enable them to make their fullest contribution to the service of the community. A report on this matter was prepared by a sub-committee under the chairmanship of Sir Lawrence Bragg and its report has been approved by the board of the Institute and has recently been published. It represents the considered views of teachers in the universities and technical colleges and of the heads of Government and industrial research establishments. Among the new activities recorded are the establishment of an Electronics Group of the Institute, and of the Joint Council of Professional Scientists, of which the Institute is one of the principal constituents.

Election of Officers

At the annual general meeting of the Institute of Physics held on July 22, the following were elected to take office on October 1: *President*, Sir Frank Smith; *vice-presidents*, Mr. E. R. Davies, Dr. W. Makower and Mr. T. Smith; *honorary treasurer*, Major C. E. S. Phillips; *honorary secretary*, Professor J. A. Crowther; *ordinary members of the board*, Professor J. D. Cockcroft, Mr. D. C. Gall, Dr. H. Lowery, Mr. D. A. Oliver, Mr. A. J. Philpot, and Mr. R. S. Whipple.

Radiant Heat for Paint Drying*

"Infra-Red" by Gas

MUCH work of a fundamental nature has been done in the Department of Fuel at Leeds University, on the problems associated with the emission and absorption of infra-red radiation, particularly regarding the sources of selective radiation. The demand for very high rates of production of paint-finished articles during the war revealed, for certain processes, a serious bottle-neck in the time required for the curing of paint in convection ovens, and it was natural that the great advantages of radiant heating should be considered as a possible solution to the problem.

Since the chief use of infra-red is at the moment for paint drying, it is necessary to consider this process briefly. The large number of different types of paints and synthetic finishes makes paint drying a highly technical subject which can only be dealt with by the paint specialist, but it is necessary to distinguish between the three main types of coating which require heat.

Coatings Requiring Heat

(1) Paint in which a solvent is evaporated, leaving an oleo-resin and a pigment; the oleo-resin must then be oxidised to form a hard paint film.

This oxidation is very slow at a temperature of 100-180° F. but may be speeded up appreciably as the temperature increases. The drying process, however, still remains comparatively slow at temperatures below that at which burning of the resin and spoiling takes place. For example, one point of this type dried at 200°F. in 2 hours, at 300°F. in 10 min., and spoiled in 2 min. at 350°F. before it dried.

(2) Lacquers in which a solvent is evaporated and no other change takes place. An increase in temperature, and in air circulation, assists in the removal of the solvent, and this type of paint rarely offers serious problems for speedy drying.

(3) Heat transformable paints, in which not only is a solvent evaporated, but there is also polymerisation of the vehicle. This polymerisation is a physico-chemical change in which simple molecules combine together to form complex molecules of the same chemical composition. The process is generally very slow at temperatures of 100-150°F., but above a critical temperature becomes very fast indeed. This temperature is less than that at which burning and spoiling of the paint occurs in a reasonable time. For example, one point of this type required 1 hour to dry at 180°F., and only 1 min.

at 230°F. The gloss of the surface, however, was lost after 5 min. at 230°F., but this 4 min. interval is a practical operating margin.

These three main types decide the most practical drying temperature and drying time at that temperature, but generally speaking it is possible to think in terms of a minute or less for lacquers, and heat-transformable paints, and 10 to 20 times as long for the oleo-resin types. It must be quite clear that the drying temperature referred to here is the actual paint temperature.

The success of infra-red drying has, in part, been due to the development of the type 3 polymerising finishes, and it must be recognised that though infra-red can greatly reduce the time required for drying other types of paint the results are likely to be less spectacular, though still of considerable importance.

In order to take full advantage of the high rates of radiant heat transfer and rapid attainment of a higher paint temperature, it is essential that full information should be available from the paint manufacturer about paint characteristics and the effects of actual paint temperature. The minimum information needed is:—

(a) The drying time needed at different paint temperatures.

(b) The minimum time in which spoiling takes place at these different temperatures.

It will then be possible to give the correct practical margin between rapid drying and possible spoiling of the paint.

Convection or Radiation?

The widespread successful use of convector ovens makes it necessary to give some analysis of the relative merits of both convection and radiation heating, since the early enthusiasm for infra-red drying has tended to create the impression that convector ovens are out of date and that they will be displaced by infra-red heating. It is true that many processes now carried out in convector ovens can be more quickly and easily performed by infra-red, but equally true that for others convection heating must remain, though incidentally the work on infra-red has indicated methods of improving convector oven practice.

For paint drying it has not been usual to operate with oven temperatures exceeding 350°F., and in a batch type oven the major heat transfer to articles in sight of the walls has been by radiation. Articles shielded from the walls are heated by convection and by radiation from work nearer the walls as this becomes heated more quickly. It will be obvious that the oven temperature must

* Extracts from a paper by L. W. Andrew B.A., B.Sc., M.Inst.Gas E., and E. A. C. Chamberlain, Ph.D., D.I.C., (B.Sc., A.R.C.S., A.M.Inst.Gas E.) Gas Light & Coke Company, presented to the Institute of Fuel on July 21.

not exceed the spoiling temperature of the paint (this frequently is within 50° F. of the drying temperature), otherwise the work nearest the walls will be burned, while the work in the centre of the oven may not be dried. This defect in the batch type oven is partially overcome by the forced convection conveyor oven, but since the walls of this type of oven are well insulated to prevent heat losses they will reach the circulating air temperature at which the oven operates. If, however, the conveyor oven can be used in such a way that articles passing through it are not shielded from direct radiation from the walls, the conveyor system can be accelerated so that the objects do not exceed the maximum safe temperature, and greatly increased rates of heating can be achieved, for in fact the conveyor oven has become an infra-red oven with the added advantage of convected heat transfer. The limiting factor is, however, the maximum temperature at which such an oven can be operated economically, and this remains for experiment to decide. It is doubtful, however, if this maximum is above 400° F., even with the best type of conveyor oven.

Comparative Figures

The following figures indicate the time taken for plates of different thickness to reach 220° F. in a conveyor oven at temperatures from 250° to 400° F. when shielded, and when in full view of the walls, and in two types of infra-red tunnel.

Gauge No. s.w.g.	Thickness Ins.	Time in minutes. Oven temperature °F.						Infra-red tunnel	
		250		300		400		650° F.	1600° F.
		Exposed	Shielded	Exposed	Shielded	Exposed	Shielded		
22	0.031	2.4	6.8	1.4	3.8	0.8	2.2	0.7	—
16	0.062	4.7	13.3	2.8	7.6	1.5	4.4	1.25	—
14	0.078	5.9	16.7	3.6	9.8	1.9	5.6	1.5	—
12	0.099	7.4	21.0	4.5	12.3	2.5	7.2	1.9	—
10	0.125	9.3	26.3	5.6	15.3	3.1	9.0	2.5	—
4	0.25	18.6	52.6	11.2	30.5	6.2	18.0	5.0	0.25
—	0.5	37.2	105.0	22.4	61.2	12.3	35.7	10.6	0.5

It will be seen from these figures for the infra-red tunnel that precise timing is very important, for if the heating period is extended the paint will be spoiled. The amazingly short times with the high temperature panel make the use of such panels difficult for paint drying except on heavy objects. It must be mentioned that with both the medium temperature and the high temperature infra-red tunnels the temperature of the air in the tunnel is only about 25° F. above atmospheric temperature.

The advantages of infra-red drying are most marked when large numbers of the same object have to be treated, and where each article can pass through the oven without being shadowed by its neighbours from the walls of the tunnel. Simple shapes with approximately the same surface to weight ratio are easiest to process, and arti-

cles with re-entrant angles require special care so that the heating of the shadowed portions by conduction will proceed at approximately the same rate as the parts exposed to direct radiation.

Shielded Surfaces

In practice it frequently happens that objects to be dried have an irregular shape with handles or other projections which shield certain parts of the surface; an extreme instance is the drying of petrol cans which have been painted internally as well as externally. Heat can only reach the shielded areas by conduction through the metal, and the temperature rise required to bring about curing of the paint must be obtained by this means. In the conveyor oven, which depended for its success on bringing the whole article up to temperature, this was no difficulty, as the rate of heat transfer through the metal by conduction is greater than the rate at which heat can be transferred from the oven by convection, so that even thick metal objects were uniformly heated, and all surfaces were dried to the same extent. With the very much higher rates of heat transfer possible with infra-red, the problem of even heating throughout the metal when shielded surfaces have to be dried becomes important.

It should already be clear that a source of infra-red rays is simply a source of radiant heat giving radiation mainly of wave lengths longer than those visible to the human eye,

i.e., longer than about 7000 A.U. All the familiar radiant heaters, gas fires, gas grills, electric fires, electric bulbs, etc., emit nearly all their radiant energy in the infra-red region.

The practical problem is to produce radiation economically; this radiation must give a suitable and reasonably uniform intensity over the whole surface of the object to be heated, and it must be substantially absorbed by the surface on which it falls. For most purposes it is desirable to have as uniform a radiant intensity as possible on all exposed surfaces of the object to be heated. The maximum economy of space would be obtained if the object were surrounded by surfaces following its own contour and placed close to it. From a practical point of view a reasonable clearance is needed between the source and the ob-

ject in order to widen the scope of any one unit to deal with objects of different size and shape. Simple shapes of unit will normally be satisfactory, for example vertical walls or parts of a spherical shell.

If sources of large area are used, each application must still be considered on its own merits, and the size and shape of the unit should be as simple as possible, *e.g.*, sheets of metal can readily be heated between vertical walls, whereas a curved shape is generally desirable if the object to be heated has a depth of the same order as its width and height. With metal objects the high conductivity is sufficient to even up minor temperature gradients, and little difficulty occurs so long as the radiating surfaces are reasonably even in temperature. The problem of design is more critical if objects of a low conductivity material, such as wood, are to be heated on the surface.

Gas and Electric Units

The electric type of unit with large numbers of lamps at the focus of parabolic reflectors needs a very careful arrangement and adjustment of overlapping beams in order to obtain uniformity of heating, and considerable stress is laid on the importance of getting the right configuration of unit for a particular job.

For gas sources, practical experience has shown that a unit with large radiating surfaces of two semi-circular sections facing each other, having a radius of 16 in., gave excellent results on thin metal sheets 2 ft. square, on metal cans 2 ft. high, 1 ft. 6 in. wide, and 6 in. deep, and on heavy tapered castings of cylindrical shape 1 ft. in length, and a maximum diameter of 4 in.

The electric type of unit can readily obtain local variations in intensity by adjustment of reflectors and spacing of the small units, but it is a matter of adjustment by a skilled person to obtain such results. A less drastic change in intensity can be obtained on a gas-heated unit by modifying the surface temperature of the unit either in a vertical plane or a horizontal plane as required—an easy matter in the initial design of the unit. It is also easy on a gas-fired unit to lower the gas rate and hence the average surface temperature and radiant intensity of a whole unit or a section of a unit, while local changes in emissivity can be achieved by painting the normally black surface with heat resisting aluminium paint.

Three samples of practical paint drying tests are here recorded:

(1) High grade white heat-transformable refrigerator paint on a steel plate 1 ft. by 1 ft. of s.w.g. 22—undercoat and finishing coat.

(2) Buff heat-transformable paint on a 19 s.w.g. steel petrol can with handles and

filling cap—overall size 18½ in. high by 13½ in. wide by 6 in. deep.

(3) Varnish on a 15 lb. cylindrical casting with tapered top—overall length 12 in., maximum diameter 4 in., wall thickness ½ in.; the casting was open at the bottom and closed at the top.

Test Results

(1) *White heat-transformable paint on s.w.g. 22 sheet steel.*—The priming coat was properly dried after 3 min. in the unit. The finish was oversteved in 5 min. The finishing coat was properly dried in 1½ min. In 2½ min. there were signs of slight deterioration in the high gloss of the finish. In a direct-fired convector oven a temperature of 590°F. was needed to dry the primer in 3 min., and the finishing coat in 1½ min. when the plate was exposed to the walls of the oven. When the plate was protected from wall radiation by polished aluminium plates the corresponding temperatures were 720°F. for the primer, and 700°F. for the finishing coat. A convector oven at 550°F. with the plates shielded from radiation took 30 min. to dry the primer, and 16 min. to dry the finishing coat.

(2) *Buff heat transformable paint on a 19 s.w.g. petrol can.*—The panels were at an average temperature of 650°F. The paint was satisfactorily cured in 5 min. with the can hung upside down, and there was no softness at re-entrants by the filling cup or shadowed parts of the handles. There were signs of spoiling of the paint after 6 min. In a direct gas-fired convector oven the air temperature needed to dry the paint in 4 min. was 590°F. with the can exposed to the wall, or 710°F. with the can protected from radiation. In a direct-fired oven at 350°F., with the can shielded from radiation, it took 30 min. to dry the paint.

(3) *Protective oxidising type varnish on a 15-lb. casting.*—With the panels at an average temperature of 650°F. the varnish was cured in 45 min., and was spoiled by scorching in 50 min.—the varnish not being destroyed but too dark in colour for the particular purpose required.

A convector oven at 350°F. took 120 min. to cure the varnish.

Conclusions

Generally speaking, radiant heating offers a simple way of getting a high rate of heat transfer to an object which requires heating. It is therefore possible to obtain a very rapid heating up of the object, and often the object is removed from an intense zone of radiation long before the ultimate temperature is attained, and then allowed to cool, or transferred to a less intense zone. Any process which can be carried out in a short time at a high temperature instead of

in a long time at a low temperature is particularly suited to the application of infra-red rays. It is important that there should be the minimum "shadowing" from the radiant heat on any part of the object to be heated, and also that objects given the same treatment should be of reasonably similar weight/surface area ratio and reasonably symmetrical in shape and uniform in thickness. It is a matter of trial to find out to what extent conductivity of the material will smooth out temperature gradients due to variations in local shape and thickness.

Practical experience shows that radiant heating can be applied successfully to many conveyor ovens used for paint and other drying processes, but is normally unsuited to the batch type of oven. It has also become clear that the possibility of increasing the normal temperature of conveyor ovens should be considered as a method of speeding up the drying of paint—care must be taken, however, to avoid spoiling of articles unshielded from the walls of the oven. Finally, it should be remembered that the choice of the best type paint may be of fundamental importance in dealing with a paint drying problem, and here the paint manufacturer can be of the greatest help.

Lord Trent on State Control

Research in Fine Chemicals

LORD TRENT, in his speech as chairman at the annual general meeting of Boots Pure Drug Co., Ltd., described the past year as one of great importance to their research department, and made special reference to the progress made in the research conducted by Dr. Pyman. "Thanks to his unceasing work," he said, "in collaboration with his staff and that of the fine chemical department, we have been enabled to make striking progress in many directions, details of which, however, cannot be given at present."

Later in his speech he referred to the working of the patent system. "We are to-day," he said, "supplying many vital and important drugs which, prior to the war, were a monopoly of the Germans, thanks to a patent system in this country which afforded them protection even though they did not manufacture here. Too much importance cannot be attached to the value of research, and when the work of the researchers produces results they are entitled to the due reward of their labours. It should be realised, however, that so long as research, experiment, and inventive genius are encouraged and financed by a reasonable system of royalties, it is contrary to public interest for the State to permit under its system of patents any monopoly of manufacture. The licence to manufacture should

be granted to any firm that can provide satisfactory assurances of its competence to do so. If international arrangements on these lines could be adopted, there would be a freer exchange of ideas and a wider availability of products, instead of an unnecessary and often uneconomical dependence upon others.

Monopolies and Bureaucracy

"The mention of monopoly brings me to an even wider question. We have heard a good deal lately about the alleged shortcomings of the large private enterprises. This criticism contrasts strangely with the urgent representations that were made to British firms before the war to organise on a large scale and work in closer association with one another in order to compete effectively with the foreigner. When politicians venture into theories about industry they are on unfamiliar ground, and their conclusions often bear little relation to the practical facts. Certainly, the assumption that the State could produce better results for the community than private enterprise is far from being borne out by the evidence that is available to us. In my view it is imperative that a halt should be called to the wild talk that is indulged in by doctrinaires on such matters. We must all recognise to-day that it is the duty of the State to protect the community against abuses, whether these are committed by private enterprise or by Government departments. But in a freedom-loving democracy such as ours it is clear that the less State regulation we have the better, and strict limits must be placed on the intervention of bureaucracy in business and private affairs."

PHOSPHATES AND THE AXIS

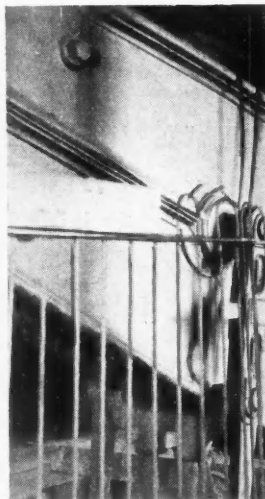
Before 1940, North Africa was supplying 50-80 per cent. of the European requirements for phosphates. Since the Allies recovered North Africa, the Axis and its satellites, with the exception of Japan, retain no substantial sources of phosphates, as the chief Russian deposits are also out of their reach. Small deposits have been worked in France, Belgium, Germany, Austria, and other countries of occupied Europe, but these are, for the most part, either uneconomic or exhausted. These sources together with probable reserves may supply the Axis military needs for phosphorus. European crops are apt to be curtailed because of insufficient phosphate fertilisers, however, and this will contribute further to the sufferings of the peoples. Japan, on the other hand, has at its disposal deposits on various Pacific Islands (Nauru, Ocean, and Christmas Islands), occupied since Japan's entry into the war.

Historic Scrap Metal

Last of a Beam Engine that Saved Twelve Lives

RECOLLECTIONS of a famous mine accident of nearly three-quarters of a century ago are aroused by the announcement that Cox and Danks, Ltd., the well-known salvage firm, are engaged in dismantling the beam engine which used to serve Nine Locks Pit, Brierley Hill, near Wolverhampton. When it is realised that the beam of the engine is 40 ft. long and weighs 26 tons, it is not surprising to hear that over 100 tons of metal will be

benefit from the fresh air currents thus set up. The pit has long been abandoned, but the engine was employed, when mining had ceased, in pumping water to prevent the flooding of adjoining pits, until it was superseded comparatively recently by electric



Above: The men rescued from Nine Locks pit in 1869. Of the three boys sitting down, Thomas Sankey, on the left, is the sole survivor to-day, at the age of 87.

Left: Mr. B. Osborne, the foreman of Cox and Danks, Ltd., at work dismantling the beam engine that helped in the work of rescue.

available for war purposes as a result of the dismantling.

By courtesy of the firm, we are able to reproduce an ancient and a modern photograph relating to the occasion. The first depicts twelve of a group of thirteen miners who were imprisoned in the pit for five days from March 17, 1869, trapped by a sudden inrush of water. The thirteenth man was dead when he was brought to the surface. Three engines were used in the work of pumping out the water during the rescue of the trapped men, one of them being the beam engine that is now in course of dismantling. The miners were saved from choke-damp suffocation by the ripples of air created by the suction from the pump, and they kept as close as possible to the edge of the water to

pumping apparatus at the bottom of the shaft.

Scrap reclamation may appear at first sight to be a drab enough subject, but there are many stories such as this "behind the scenes." The lives of ten men and three boys, five days of anxious suspense, and an engine of 1864 originally costing £25,000 are the unexpected items behind this one cargo of steel for the munition works.

The Iron and Steel Trades Confederation has asked its 700 branches to urge their 92,000 members to contribute an extra penny a week to the national Red Cross Penny-a-week Fund.

Personal Notes

MR. PHILIP ROBINSON has been appointed an additional director of Lewis's, Ltd.

MR. CHARLES ROBSON, secretary of Ashmore, Benson & Pease, Ltd., Stockton-on-Tees, has been elected a member of the Stockton Town Council.

DR. ERWIN E. NELSON, director of pharmacology at Tulane University, New Orleans, has been appointed director of the Wellcome Research Laboratories at Tuckahoe, New York State.

DR. T. A. HENRY will be retiring from the Wellcome Chemical Research Laboratories (London) on August 31, after which the laboratories will be merged in the Wellcome Bureau of Scientific Research. Dr. Henry's work in the field of plant alkaloids is well-known and his book *The Plant Alkaloids* is regarded as a classic. The laboratories under his direction have always specialised in the chemistry of tropical medical research and will continue to do so.

On Tuesday, SIR JOHN RUSSELL received the Albert Gold Medal of the Royal Society of Arts. Dr. E. F. Armstrong, the Society's president, making the presentation to Sir John, said "You have made yourself the foremost agricultural scientist



Sir John
Russell.

in the world." Sir John, who retires from the directorship of Rothamsted Experimental Station at the end of September, began his scientific career as a chemist, becoming a lecturer in chemistry at Victoria University (now merged in Manchester University) after graduating there. His association with agricultural science dates from his joining the late Sir Daniel Hall at Wye Agricultural College. He succeeded Hall as Rothamsted's director in 1912.

PROFESSOR H. S. RAPER, Brakenbury professor of Physiology at Manchester University and formerly professor of physiology and biochemistry at Leeds University, is to

receive the honorary degree of LL.D. of Leeds University in October. The University is also conferring an honorary degree, a D.Sc., on MR. E. V. EVANS, general manager of the South Metropolitan Gas Co., Ltd. Mr. Evans is a past president of the Institute of Gas Engineers, and has given much help to the gas research work carried out at Leeds.

Obituary

MR. FREDERIC WILLIAM LOUIS CREPIN, who died at Suaresbrook, on July 22, aged 74, after a long illness, was chairman and director of Crepin and Doumin, Ltd., essential oil merchants. He had served with the company ever since its foundation in 1919.

MR. LAWRENCE LESLIE TWEEDY, president of the American Chamber of Commerce in London, died suddenly on July 26 at Fraserburgh, Aberdeenshire, having been on a journey to Scotland to witness the presentation of the Freedom of the City of Aberdeen to the American Ambassador. Mr. Tweedy, who was 61 years of age, had been associated with this country since 1912, and had held office in the Chamber of Commerce for 13 years, having been director since 1927, vice-president in 1933, and president since 1938. He was an original member and vice-chairman of the London Committee (set up in 1940) of the American Red Cross in Great Britain.

Steel Analysis

New Research Methods

THE British Standards Institution has just issued specification B.S. 1121 (Part 1) 1943, which includes recommended methods for the determination of sulphur, phosphorus, and lead in steel. This is the first instalment of a programme of work for the preparation of standard methods for the analysis of steel generally. As sulphur and phosphorus are the two elements which are specified more frequently than any other, attention has been given to them first of all. The determination of lead was included as it was a point of considerable importance at the present time in the development of leaded steels.

Work is proceeding in the preparation of methods for the determination of carbon and manganese, and will ultimately cover all alloying elements. The experimental work is being carried out by a Committee of the Iron and Steel Institute, and very close agreement was obtained in the results of the various investigators who tried out the methods for sulphur, phosphorus, and lead. Copies of this specification may be obtained from the British Standards Institution, 28 Victoria Street, London, S.W.1, price 1s.

General News

Rumours connecting Courtaulds and Thomas De La Rue in the development of the post-war plastics industry have been officially denied by the last-named company.

We are informed by the British Standards Institution that the English Edition of the Chemistry section (Class 54) of the Universal Decimal Classification is now available as B.S. 1000, vol. 2, part 2 (price 10s.).

The Ministry of Food announces that there will be no change in the existing prices of refined oils and imported edible animal fats allocated to primary wholesalers and large users during the eight-week period July 5 to September 18, 1943.

The Ministry of Supply's functional organisation is well set out in Bulletin No. 27, published by the War-Time Trading Information Bureau, 17/19 Henrietta Street, London, W.C.2, and prepared in conjunction with the Ministry. Giving lists of executives, etc., it is a useful reference booklet.

Standard plants for the dehydration of vegetables are to be erected by I.C.I. on behalf of the Ministry of Food, according to a statement by Lord Woolton. The plants now in course of erection would be brought into operation during the next three months; their entire output would be required for the Armed Forces.

Richest sources of vitamin P, to judge from results by A. L. Bacharach and M. E. Coates in *J. Soc. Chem. Ind.* (June, 1943, p. 85), are the blackcurrant, lettuce, cabbage, spinach, walnut kernels, and rowan berries. Fruits appear to contain the greatest amounts, with green leaves at least a good second.

The directors of I.C.I. are entering into a deed of covenant to pay £4000 a year for seven years to King George's Fund for Sailors. Half this amount is to be allocated to Merchant Navy funds and half to Royal Navy benevolent funds. The First Lord of the Admiralty has made special mention of this generous gift in a letter of thanks for the response to his broadcast appeal made on July 11.

The Wellcome Foundation is planning a considerable expansion of its research activities, including further development of the chemical research laboratories at Beckenham under Dr. Sydney Smith. Various changes in the organisation of the laboratories will be made in order that the Foundation's research plans, as well as those carried on in collaboration with government departments, the Therapeutic Research Corporation, and other bodies, may be fully realised.

From Week to Week

Voss Instruments, Ltd., have now had the telephone installed in their new premises. Their telephone number is GLAdstone 6600.

The British Museum has received a large quantity of publications of the Soviet Academy of Sciences from the Lenin Library in Moscow.

The Anglo-Spanish, Anglo-Turkish, Anglo-Italian, and Anglo-Roumanian Clearing Offices moved on July 26 to 29 Lennox Gardens, London, S.W.1 (Telephone: KENSington 9425; Telegrams: Conasco, Knights, London).

Spraying of potato crops with sulphuric acid has commenced and will continue during the next four weeks. It is being pointed out to farmers that, in past seasons, delay on the part of growers in returning carboys to the suppliers has seriously affected the distribution of acid for this purpose.

The foundation of a research laboratory for physical chemistry is suggested as a fitting tribute to Dr. George Senter, the late principal of Birkbeck College, who died last year. He left the college a benefaction of £1000, which the governors of the college propose to use as the nucleus of the research laboratory fund.

The Council of Leeds University has approved regulations for the Lowson scholarship in chemistry recently endowed by a gift of £2000 from Mr. William Lowson, senior lecturer in analytical chemistry. The scholarship has for its object the encouragement of interest and proficiency in analytical chemistry. It may be awarded either as a senior (undergraduate) scholarship or as a post-graduate scholarship for research.

Carbon monoxide as the cause of some cases of heart disease was suggested at the annual meeting of the National Union of Blastfurnacemen, Ore Miners, and Coke Workers, by the general secretary, Mr. A. Callaghan, who asked that all suspected cases be reported without delay. He mentioned that 74 deaths from heart disease occurred among workers in these trades during 1942.

Economy in the use of steam for cooling firebeds and bars in industrial furnaces and boilers is the text of *Fuel Efficiency Bulletin* No. 20 of the Ministry of Fuel and Power. Practical measures for attaining due economy in this respect are detailed in the first part of the bulletin, and these are followed by an interesting theoretical discussion of the principles of firebed cooling. It is shown that the direct cooling effect of steam is much less than the cooling effect of water used in the same way.

Shellac stocks in Britain are sufficient for direct war needs for at least a year, while America has enough for two years, states the Ministry of supply.

The Sixth Addendum to the British Pharmacopoeia 1932 has now been published and becomes official on August 1. Copies can be obtained from Constable and Co., Ltd., 10 Orange Street, London, W.C.2.

The Building Research Board's chairman, Sir George Burt, is a member of the mission which the Ministry of Works is sending to America to report on new building methods.

Honeywill & Stein, Ltd., have returned to London, and their address is now 21 St. James's Square, London, S.W.1 (telephone: WHITEhall 8021/7; telegrams: Brostein, Piccy, London; Tyche, Piccy, London).

Fifteen thousand workers at a North of England war factory have unanimously agreed to double their weekly contributions to the Red Cross Penny-a-Week Fund. Workers in nearly 44,000 firms and organisations are contributing each week.

Nicotine factories receive all tobacco which is damaged or deteriorated beyond the stage at which it can be reconditioned, stated the Chancellor of the Exchequer in reply to a question in the House of Commons from Mr. Parker, asking to what extent tobacco and other goods on which duty has not been paid are destroyed instead of being used to the national advantage.

A simple means of reconditioning carbon papers is being used by Messrs. Pilkington Brothers of St. Helens. They have found that by passing the carbons over a steam pipe, with the uncoated side next the pipe, the composition on them melts instantaneously and respreads itself equally. The carbons dry quickly as soon as they are removed from the heat, and look almost as good as new.

The establishment of a council of engineering institutions, for the purpose of co-ordinating the education and training of engineers, has been suggested by Sir Roy Fedden in an address to the Engineering Industries Association. He described himself as greatly impressed by the large numbers of technically trained engineers passing out from American universities, many of which he visited in his recent North American tour.

Correct installation and proper inspection of industrial rubber products are the keynotes of a booklet, "Industrial Rubber Products Conservation," just published by the Goodyear Tyre and Rubber Co., of Wolverhampton. Industrial rubber products—conveyor and transmission belts, hoses, etc.—being one of the most important essentials in our war effort, this booklet, with its clear diagrams and explicit instructions, is a valuable asset to any factory using rubber in its plant. Further details are obtainable on application to the Goodyear company.

At a north-west port last week detachments of the National Fire Service had the difficult task of extinguishing a fire aboard a 7000-ton ship, the cargo of which included a quantity of phosphorus packed in 40-gallon steel drums. Some of the drums had broken, and when the hold was opened for unloading the phosphorus ignited.

Micro-photography is now being used extensively by several large business concerns as a paper- and space-saving measure. At Unilever House two micro-photographic cameras are in constant use, one the Recordak and the other the Graflex. By means of these, documents both large and small, as well as books, can be photographed on 16 mm. and 35 mm. films which occupy only 1 per cent. of the space of their paper originals. Unilever House is now sending an average of 52 tons of paper to salvage each quarter and the bulk of this is obtained through release of documents which have been micro-photographed recently.

Foreign News

The Argentine Government has authorised the use of 2,000,000 tons of wheat as fuel. The country has no coal or oil, and her imports of fuel are now largely cut off.

A large chemical plant and the Taponelli steel works near the San Lorenzo railway centre were damaged in the recent raid on Rome.

Small aluminium printing presses, weighing only 23 lb., are among the articles being smuggled into occupied countries on the Continent, states the U.S. Office of War Information.

The office of the Canadian Trade Commissioner for Colombia, Panama, the Canal Zone, Nicaragua, Costa Rica, and the Netherlands West Indies has been transferred from Panama to Bogota. Address: c/o Royal Bank of Canada, Bogota, Colombia.

In accordance with a "most-favoured-nation" agreement that has been arranged between Mexico and Chile, certain Chilean products will later be given special tariff treatment on importation into Mexico. These will include fertilisers, sulphur, salts of sodium and potassium for industrial use, and pharmaceutical and biological products.

The Swedish chemical industry enjoyed a boom year in 1942, owing to the lack of imports, states the annual report of the Sveriges Industriförbund. Liquid fuels and other products were made in large quantities from Swedish wood and shales, while the apatite ore found in northern Sweden assured the supply of phosphate fertilisers for the country's agriculture, and the output of nitrogenous fertilisers was also further enlarged.

Nazi metallurgical experts have arrived in Milan to discuss the evacuation of the more important plants of the Italian Montecatini Mining and Metals Trust to Germany, states a Tass Agency report from Geneva.

The Heroya aluminium and magnesium works, about 65 miles S.W. of Oslo, Norway, which were bombed by the United States Eighth Army Air Force on Saturday last, were due to start production this summer, after constructional work which had been proceeding since the autumn of 1940.

More Swedish iron ore is being sent to Germany via Narvik, states a Swedish Foreign Office spokesman, quoted by Reuter. The report adds that about a dozen ships leave the port each week. It is three years ago since Narvik's ore-loading quay was badly damaged, and it is now in working order again.

Southern Rhodesia's mineral production for 1942 was worth £9,377,166. Base metals and minerals accounted for £2,976,848, representing an increase of some 30 per cent. over the preceding year. Security considerations have led to details being kept secret, but it has been announced that 22 base minerals were produced, with asbestos, coal, tungsten, chrome and mica among the most important.

Hydrogenation of benzene is catalysed by palladium, according to results published in *J. Amer. Chem. Soc.* (June, 1943, p. 1029). With alloys of palladium with silver—the latter is inactive—catalysis decreases as the palladium content is lowered. Copper is also found to be inactive, though the addition of a small amount of nickel results in slight catalytic activity.

Bismuth trioxide, hitherto considered dimorphic, has been obtained in a third crystalline form by Walter C. Schumb and Edmund S. Rittner (*J. Amer. Chem. Soc.*, June, 1943, p. 1055). The new modification, which has body-centred cubic crystals, was prepared by heating the tetragonal variety of the oxide to 750-780° C. and allowing to cool. More rapid cooling produced the other two allotropic forms.

Aerial photographs show that at Oberhausen important industrial targets were hit during the night of June 16 and in earlier attacks. There was major damage at the Deutsche Babcock and Wilcox boiler works, and a number of buildings were damaged or destroyed in the high priority Gutehoffnungs Hütte A.G. steelworks. The Concordia by-products plant and coal mine appear to be inactive, and many pithead and other buildings were hit. A chemical works, zinc works, tar factory, and glass factory, together with railway workshops and the important Osterfeld marshalling yards, were also seriously damaged.

CHEMICAL EDUCATION

A recent conference held, at the suggestion of the Chemical Council, by the three chartered bodies, the Association of University Teachers and the Science Masters' Association, resolved that a Chemistry Education Advisory Board be set up immediately to consider all aspects of education in chemistry, but not the education of the public concerning chemistry and the activity of chemists. It was agreed that members of the board should be appointed in their individual capacity, not as representatives of the participating organisations. The board will have the power to appoint committees or panels to deal with the various aspects of education in chemistry, either from among their own number or by co-opting selected individuals.

SHARK-LIVER OIL

An account of the chemical properties of shark-liver oil is given in *Revista de Agricultura Industria y Comercio de Puerto Rico* (1943, 34, 2, p. 205). It is stated that typical specimens of two local species of ground shark yield an average of three gallons of oil, the specific gravity of which ranges from 0.9 to 0.86 owing to the presence of varying amounts of the highly unsaturated hydrocarbon squalene. Chemically squalene ($C_{30}H_{48}$) can be considered a polymer of isoprene to which two atoms of hydrogen are added. Experiments at the School of Tropical Medicine with oil from Puerto Rico sharks showed a vitamin A content of 13,000 to 14,000 Sherman units per gm. Average cod-liver oil runs from 800 to 1000 units. Vitamin D, on the other hand, was low (50 units per gm.) compared with cod-liver oil (200 units per gm.).

VERMICULITE

Vermiculite, an alteration product of phlogopite and biotite micas, varies in colour from white to yellow, brown, bronze and green. Its most important property is its expansion on heating to about 20 times its original volume, the specific gravity being reduced from 2.5 to .09, or even less. In this condition it weighs from 6 lb. to 20 lb. per cubic foot. World production of the mineral dates from 1923, when it was planned to work a deposit in Colorado, the intention being to use the treated product as an insulating material for steam pipes, refrigerating equipment, insulating bricks, wall boards, etc.

About the same period plans were also made to work a deposit in Montana and sell the exfoliated material as an aggregate in magnesium oxychloride cement products, or as a light-weight fireproof substitute for insulating cork.

COMPANY MEETING**Beechams Pills, Limited**
Increased Profits

The annual general meeting of Beechams Pills, Limited, was held on Thursday at the May Fair Hotel, London, W.

Mr. Philip E. Hill, the chairman, in the course of his speech said: Ladies and gentlemen, I am glad to be able to meet you at the commencement of the second centenary of your business with a successful year's trading to report. For the eleventh successive year your directors are able to report increased profits, this year's trading profits being £94,119 up at £1,269,334. This year our accounts are in a slightly different form, to comply with the requirements of the Paper Control.

From a perusal of the accounts it will be seen that we made a profit of £51,512 on the sale of investments of which your directors considered it prudent to dispose in view of the favourable prices obtainable. The profit on these transactions has been added to the carry-forward. The year has not been an easy one, as the raw material position has been more difficult than last year, and quotas and other restrictions have militated against sales expansion. However, I am glad to say that in spite of these facts, sales of the group's products were substantially in excess of those for the previous year. Our new subsidiary companies, which were acquired in continuation of the board's policy of extending the business of the group beyond proprietary medicines, have all done well and have contributed satisfactory dividends. Your directors are satisfied with these acquisitions.

Higher Dividend

Our export trade has suffered somewhat severely from increased Dominion and foreign taxation and from the stringent shipping restrictions. I am glad to say, however, that we have held our own in the major markets, and are ready to follow our policy of expansion as soon as times are favourable. New lines have been put on the markets, and their successful exploitation is only a matter of time. Your directors felt justified this year in slightly increasing the dividend on the deferred shares, which I hope meets with your approval. Once again the company has contributed a large proportion of its revenue to the National Exchequer, as apart from purchase tax, nearly one and a half million pounds has been or will be paid to the Chancellor in taxation. Our staffs have been still further depleted by the calls of the services and munitions. It is impossible for me to prophesy what the next year's results are likely to be, but I am glad to be able to tell you that so far sales show an increase over last year.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BI-METAL PRODUCTS, LTD., London, S.W. (M., 31/7/43.) July 7. £5, £500, £150 and £5 debentures, parts of a series already registered; also July 14, £715 debentures, part of a series already registered.

BRITISH ALUMINIUM CO., LTD., Shrewsbury. (M., 31/7/43.) July 12, disposition by Miss A. G. Bisset and others, with consent of company granted in implement of a trust deed dated September 12, 1934; charged on subjects at Gedsmlin, Burntisland. *£3,312,318. April 13, 1943.

Company News

Catalin, Ltd., record a loss for 1942 of £2388 which, added to the deficit brought in, leaves a debit forward of £33,188.

Splintex Safety Glass, Ltd., announce a net profit of £13,128 (9175). The debit carried forward is £29,003 (£37,328).

International Diatomite, Ltd., record a net profit of £2294 (£600), and are paying a dividend of 3 per cent. (nil). Forward: £1084 (£1040).

Tunnel Asbestos Cement, Ltd., report a net profit of £34,585 for the 13 months to December 31 last (£32,185 for previous 12 months). Dividends are being paid of 5 per cent. on ordinary shares for the year (same), and also in respect of the 18 months to December 31 last on the 5½ per cent. preference shares.

New Companies Registered

Arco (Laboratories), Ltd. (381,844).—Private company. Capital: £2500 in 2500 shares of £1 each. Laboratory proprietors, research workers, analytical and consulting chemists, etc. Subscribers: Jane Lendeter; Muriel P. Pinkney. Registered office: 10-11 St. Dunstons Lane, E.C.3.

Walker (Drysalters), Ltd. (22,480).—Private company, registered in Edinburgh. Capital: £100 in 100 shares of £1 each. Soap merchants, dealers in cleansing solvents of all types, etc. Subscribers: W. Douglas Cochran; J. Joan Mackenzie. Registered office: 178 St. Vincent Street, Glasgow.

Whitehead Chemical Co., Ltd. (381.623).

—Private company. Capital: £1000 in 1000 shares of £1 each. Manufacturers of and dealers in chemicals for use in the manufacture of rubber, paper, paint, textile, food, metal, plastic and other commodities and products, the processing of raw, synthetic, and waste rubber, bitumen, lacquers and emulsions, manufacturers of plastics, moulding powders, synthetic resins, etc. Subscribers: A. Whitehead; G. A. Clare. Registered office: 10 Norfolk Street, Manchester, 2.

Chemical and Allied Stocks and Shares

THE upward movement in security values has been continued in Stock Exchange markets, where sentiment was dominated by the resignation of Mussolini. Attention centred mainly on industrial securities, particularly on shares of companies whose dividends during the war have been well below the rates paid prior to 1939, and which, according to current market assumptions, may have reasonable possibilities of improving dividend payments after the war. Gilt-edged stocks and front rank investment securities were relatively dull.

Movements among shares of chemical and kindred companies reflected the general trend in equity securities. Considerations of current yields were not an important market factor, and there was not a great deal of movement among shares which have had a steady dividend record both before and since the war. Imperial Chemical, for instance, whose dividend has been kept on an 8 per cent. basis, and which show a yield that compares favourably with those of various other leading industrials, were unchanged at 39s. 3d. On the other hand, Turner & Newall at 78s. 6d., Wall Paper Manufacturers deferred at 40s. 3d., Lever & Unilever at 36s., and Barry & Staines at 45s. were among shares which recorded further good gains on the assumption that as time proceeds there may be scope after the war for dividend rates to return to those ruling prior to 1939. Various shares of companies connected with plastics also remained prominent, and Thomas De La Rue rose further to £8, while elsewhere, the units of the Distillers Co. were 87s. 6d. Shares of companies associated with the building trade were also in better demand at higher levels; Associated Cement advanced strongly to 63s. 6d., Pinchin Johnson to 35s. 3d., and British Plaster Board to 28s. 9d.; while elsewhere British Oxygen were 75s., and Dunlop Rubber appreciated further to 39s. 3d. Other shares which were in request despite the small current yields included Boots Drug at 41s. 9d., and Triplex Glass 10s. ordinary, which rose to 34s. 9d.

Firmness was maintained in B. Laporte at 78s., and in Metal Box at 90s. Elsewhere, Leeds Fireclay ordinary were more active around 6s. 6d., and the preference shares, on which dividends were resumed earlier in the year, were better at 17s. 3d. Gains have been recorded in Bleachers, Bradford Dyers and other leading textile shares, while there was a strong rise to 28s. 6d. in British Celanese, and Courtaulds moved up further to 54s. 9d. On the other hand, iron, steel and kindred issues showed only moderate response to the buoyant trend of markets; Dorman Long were 26s. 10½d., Stewarts & Lloyds 52s., Staveley 53s., and Tube Investments 91s. Guest Keen were 31s. 1½d. under the influence of the recently-issued results, which showed that the 10 per cent. dividend was again conservative and permits of further large additions to reserve funds; earnings on the ordinary capital exceeded 17 per cent. Richard Thomas 6s. 8d. ordinary shares rose to 11s. 4½d. under the influence of the higher dividend.

Fisons ordinary were 49s., while British Drug Houses remained at 21s. 3d., Burt Boulton around 19s., and Greff-Chemicals 5s. ordinary were 7s. 3d. General Refractories 10s. ordinary showed firmness at 16s. In other directions, Borax Consolidated further improved to 35s. Sangers 5s. ordinary remained firm at 22s. 7½d. under the influence of the dividend, and at 31s. 3d. Timothy Whites were within a few pence of the level ruling a week ago. Amalgamated Metal shares were 17s. 3d. awaiting the financial results. Imperial Smelting strengthened to 14s. 7½d. Oil shares were again better with attention centred mainly on Anglo-Iranian and Burmah Oil.

British Chemical Prices

Market Reports

FRESH buying interest in heavy chemicals on the London market during the past week has been on a moderate scale but deliveries against existing contracts are well up to schedule and sellers have little of which to complain in this respect. In the meantime the strength of the market is maintained in nearly all sections and a very firm undertone is reported. Among the soda compounds nitrate of soda is unchanged in price with good quantities coming into consumption while the solid grades of caustic soda are being taken up steadily, chiefly against contracts, and a fair inquiry for liquid caustic has also been dealt with. Offers of yellow prussiate of soda are still restricted with values covering a fairly wide range. Bicarbonate of soda is an active section with deliveries well maintained, and a moderate weight of new business in soda ash has been reported. The sulphides are moving steadily

against contracts and some new inquiry has been reported. There is little change on balance in the market for potash chemicals. Permanganate of potash is in steady request and all offers are readily taken up. Solid caustic potash and bichromate of potash remain in short supply relative to requirements, while a fair business is being transacted in acid phosphate of potash. In the coal-tar products market a fair trade is reported in pitch and the anthracene oils, while cresylic and carbolic acids are a good market. The pyridines are attracting moderate attention, while steady trading conditions are reported in toluol, benzol and xylol.

MANCHESTER.—Chemicals, along with most other sections of the Manchester markets, are to some extent under the influence of holiday conditions, and this factor is likely to operate during the whole of the coming month. Notwithstanding this, however, there is still a fair movement of contract supplies of textile chemicals to the Lancashire cotton and the West Riding of Yorkshire woollen mills, though the past week has not witnessed much in the way of actual new buying. The demand for sulphuric, hydrochloric and oxalic acids has been on steady lines, and there has been a fair call for most of the alkali products. With regard to the by-products, crude tar and creosote oil are active sections and there is a steady demand for most of the light distillates.

GLASGOW.—In the Scottish heavy chemical trade business for the past week in the home trade has been very quiet on account of the annual holidays, most firms being closed for the entire week, but normal business should be resumed this week. Prices remain very firm. Export trade is still rather restricted.

Price Changes

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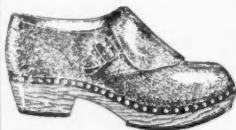
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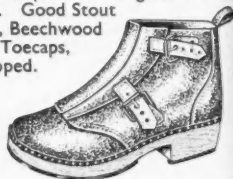
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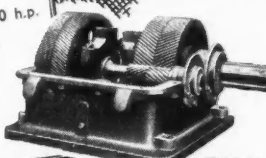


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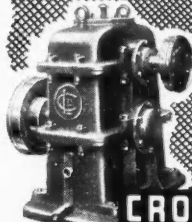
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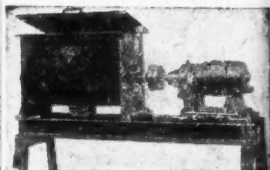
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